COLOR TV TODAY

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DECEMBER
1955
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IN THIS ISSUE

FACTS TO KNOW WHEN BUYING A PREAMP

MODULES IN TV RECEIVER DESIGN

AN ELECTRONIC SLIDE RULE

A NOVEL FREQUENCY MODULATED V.F.O.

TEST EQUIPMENT FOR COLOR TV

SHIELDING IN HI-FI EQUIPMENT

TROUBLESHOOTING TELEVISION I. F. STRIPS

PUSH-PULL SPEAKER SYSTEM

EVOLUTION OF THE PHONOGRAPH

SINGLE-SIDEBAND SYSTEMS
(See Page 114)

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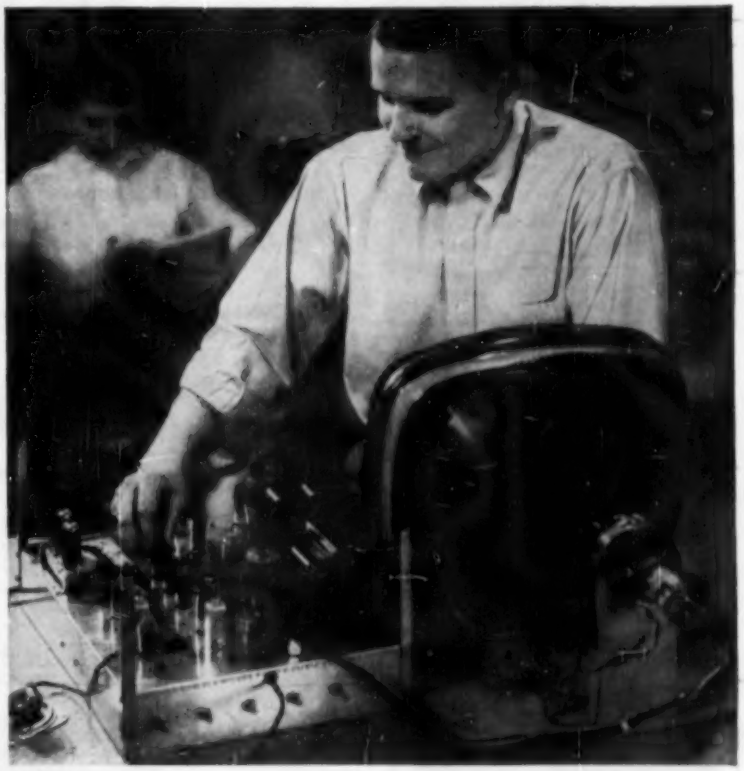

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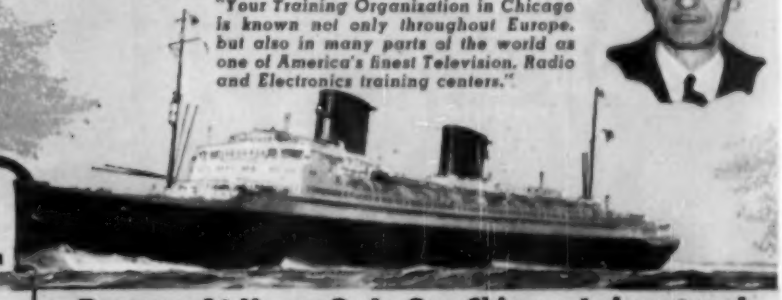

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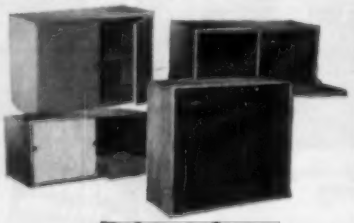

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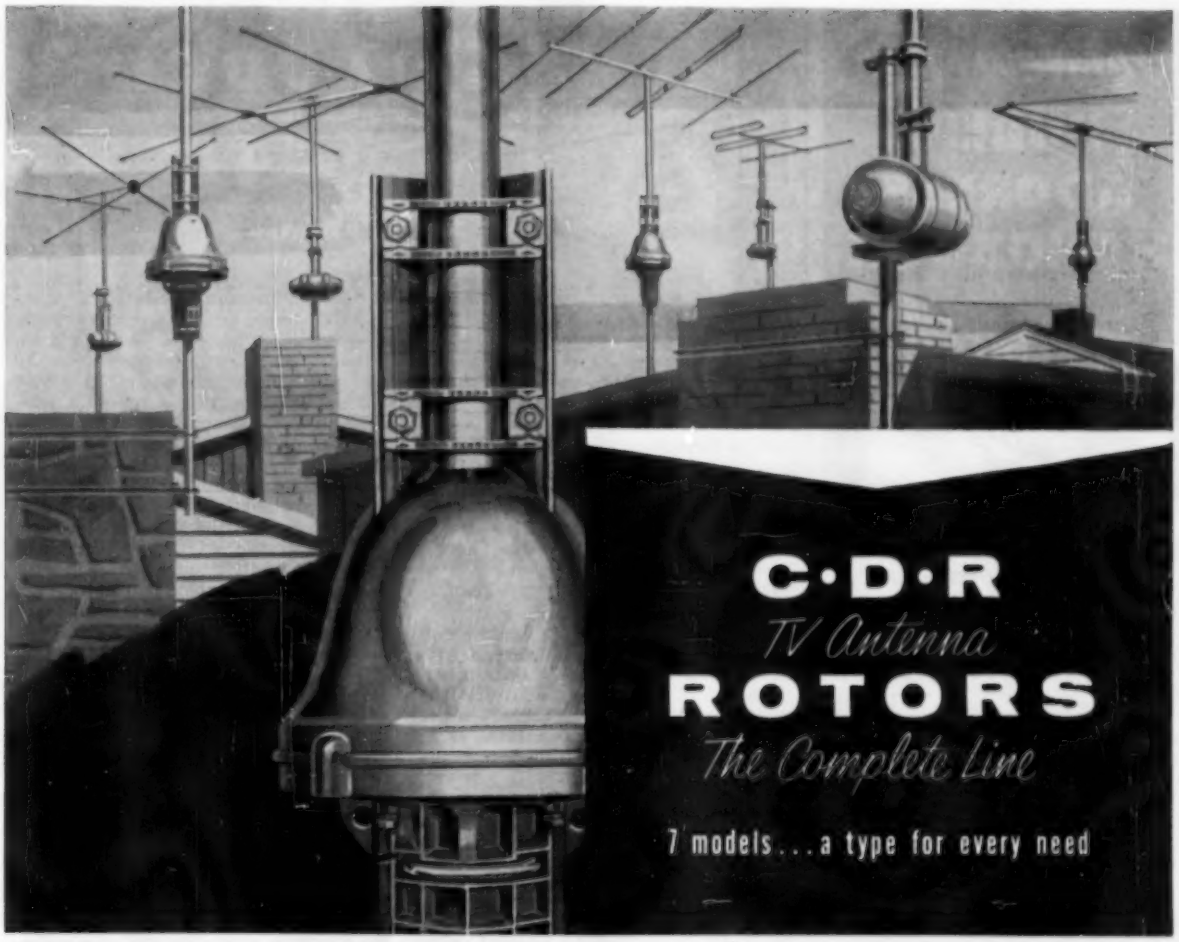

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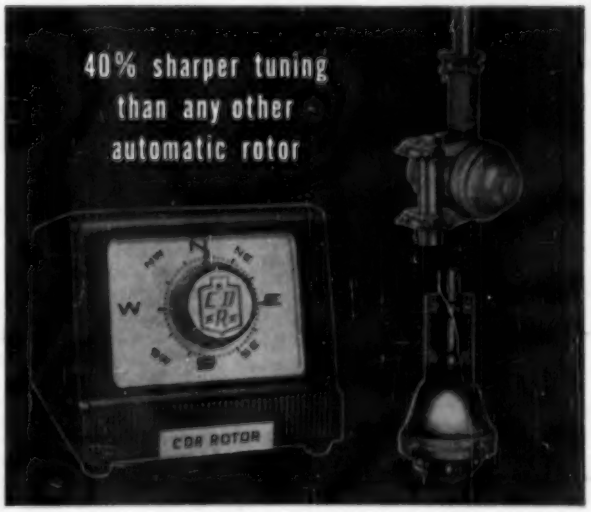

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For the RECORD

BY THE EDITOR

AT THE AUDIO FAIRS

AT THIS writing, two major Audio Fairs have just been completed, and at least two more are coming up in the very near future. So, it is understandable if our thoughts at this time are primarily about audio matters.

Fairs of this kind are always fascinating—there is an air of excitement all about, and the noises emanating from the various rooms tend to impart a carnival atmosphere—though for the most part the "barkers" are not as evident as at a carnival. The true barker, in many instances, has been replaced by a pretty girl handing out reading matter of various kinds.

It is extremely interesting to listen to the various demonstrations of hi-fi equipment. As usual, the demonstrations are way too loud, but for the most part this is in self defense—if the volume were turned down, noise from nearby rooms would drown out the program material. Also, with low volume, the number of people entering the room diminishes.

There was one notable exception to the above generalization at the New York Audio Fair. Our "Phonorama" exhibit, with an old *Edison* acoustic phonograph providing the sound, attracted a great deal of interest, even though the phonograph could be heard only a few feet down the hall. Perhaps this interest resulted from a desire of visitors to get away from the ear-splitting sound in other rooms—perhaps it was the novelty of the whole thing. In many cases, it was pure nostalgia!

At any rate—our historical display of 35 early disc and cylinder phonographs, from the collection of this editor, was received with great enthusiasm. We now have a total of 87 machines from the 1889-1906 period.

Speaking of ear-splitting sounds—did you ever have 120 watts of audio from a kettle drum hit you in the pit of the stomach? It is quite an experience! Much worse than as though you were inside the kettle drum! How a voice coil can be made to handle such power without being torn apart is somewhat hard to understand, but it has been done. It is somewhat doubtful if a normal living room could long stand up under the punishment of 120 audio watts, let alone a human being, but there must be places where such a system can be used to good advantage.

Stereophonic sound in various forms is gradually taking hold, although true stereophonic systems are still rather expensive. Which brings up one of our pet peeves—the indiscriminate use of the terms "binaural" and "stereophonic." The terms are *not* interchangeable if the true definitions are adhered to, although many manufacturers use the two terms indiscriminately. In a true binaural system, two completely independent audio channels are used, with the two microphones spaced a distance apart approximately equal to the distance between human ears. Sound is then presented to the ears by means of headphones—the left-hand microphone feeds to the left headphone, and the right-hand microphone to the right headphone. True binaural cannot be accomplished with loudspeakers. As soon as speakers are used, the system becomes "stereophonic." Unfortunately, we are compelled to use the terms "binaural" and "stereophonic" interchangeably ourselves occasionally, because of the way manufacturers describe their equipment, but we will keep the distinction clear wherever possible.

Another pet peeve of many years' standing is the amount of surface or background noise present in many of the demonstrations. Hi-fi fans used to welcome such noise or scratch as indicating that their systems were true "hi-fi". With presently-available equipment and techniques, however, any great amount of such noise is inexcusable and will backfire to the detriment of the demonstrator.

A matter exciting a considerable amount of discussion at both the Chicago and New York Audio Fairs was the introduction of the ½-mil stylus. We will cover the technical aspects of the matter in an article in the near future, but want to report on some of the discussions briefly at this time. Some engineers claim that the bottom of the groove in most microgroove recordings is wider than ½-mil, which means that a ½-mil stylus would "rattle around" and produce all sorts of distortion and weird effects. Others claim that the bottom of the groove is about ¼-mil wide or less, which is adequate for a ½-mil stylus. The demonstrations we heard with a ½-mil stylus sounded very good—which is encouraging! Of course, actual pressures on the walls of the groove will be much greater with the smaller stylus unless needle force is reduced, so care must be taken to make certain that the record material is not distorted beyond its elastic limit. It is natural to assume that the large majority of ½-mil styli will be diamond, if this size is generally accepted . . . . . O.R.

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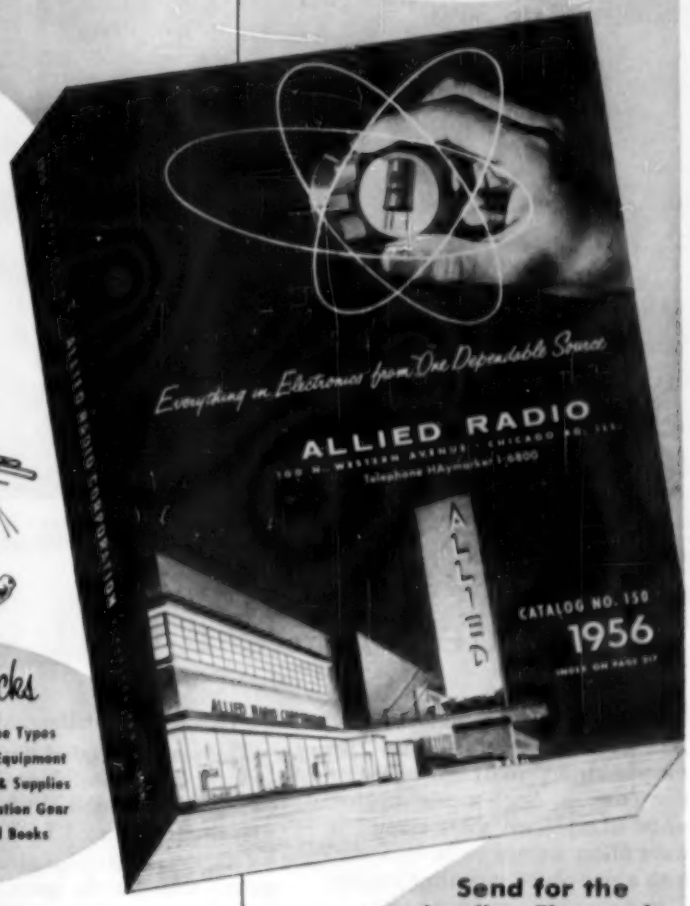

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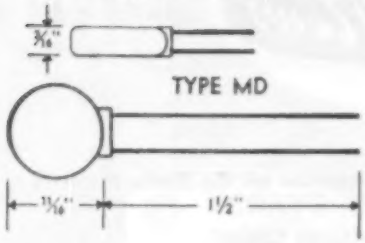

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Spot Radio News

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By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

THE UNMANNED SPACE SHIPS, now being designed for travel into the world beyond and which will be fully equipped with an array of transmitters and receivers for telemetering and aeroguidance, have been panelled for special allocation considerations. A mixture of super-high and lower frequency channels are being discussed as possibilities, to permit long distance penetration and short-line jumps, the thousand-megacycle region being reviewed for the short-distance hops, using higher power, and the lower bands for the extended runs with lower outputs.

The speeding moons are not only expected to aid astronomers and physicists, but broadcasters, too. Many believe that these satellites can be used as broadband repeaters for transoceanic radio and TV signals. About a year ago a proposal in this direction was submitted to the National Science Foundation. Suggested then was a chain of spheres, in orbits about 2200 miles from the earth, which would provide contact with any satellite from any location on the earth. Another method offered involved repeaters or plane mirrors about 20,000 miles above the equator that would serve as signal bouncers for radio or television signals. Antennas some 250 feet in diameter might have to be used for such transmissions, the band for video work would have to be about 5 megacycles wide and the frequency, 1000 mc. Commenting on the powers that might be used, the report said that, depending upon the size of the moon and its distance from mother earth, the base transmitters would have to have a wide range of outputs, from 100 watts to perhaps 10 megawatts.

THE VERY-HIGH/ULTRA-HIGH situation, which has been beleaguered by reams of varied ideas on possible solutions, was hit by another radical proposal a few weeks ago, that would completely alter the up and downstairs allocation program. Offered by FCC Commissioner Robert E. Lee who felt that the u.h.f. band was going nowhere and appeared hopelessly enmeshed in trouble, the plan suggested that additional v.h.f. channels should be squeezed out of existing allocations and separations between stations should be lowered. The latter step could be taken, it was said, by using directional antennas and permitting the installation of low-power local stations. A shift of channels and extension of the bands would solve the station drop-in problem. First, said the Commissioner, the 216 to 342-megacycle region would have to be cleared away, as suggested in an earlier report; this would mean that the military, public, safety, and government services would have to be given channels elsewhere. Then, the 132-174 mc. band would have to be surrendered to low-band TV; such a move would provide seven more v.h.f. channels. Here, too, the present occupants, involving hams, maritime, industrial, transportation, domestic, and Washington agencies would have to move out and perhaps over to channels above 500 mc.

The Commissioner's ideas were challenged by many in Washington and industry, who felt that the proposed shifts would not only result in restricted services, but would curb the national expansion of television, as originally envisioned. These views were based on the limited number of very-high channels that would be available, regardless of the shifts made, and the legal and technical difficulties that would be encountered in moving the government agencies out and up to the higher frequencies. Congressional approval might be required before such action could be taken.

The separation reduction was also looked on with suspicion. A number of experts bluntly feared that such a cutback would raise cain, causing the same chain of exasperating interference problems that brought on the five-year freeze.

THE USE OF TAPE for other than entertainment purposes has concerned many for a long time, particularly those engaged in computer work. In one such study at the Bureau of Standards recently, a striking discovery was made. It was found that it is possible to pack digital pulses closely on tape, and thus reduce problem-solution time by providing more rapid access to recorded information.

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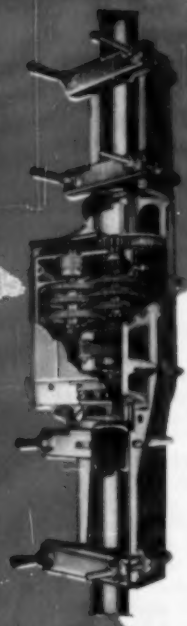

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AMPHENOL

speed memory, or in some cases as both. Many types of mathematical problems require extensive use of an external storage system. In solving these problems relatively little actual computation is performed, but a great deal of data must be handled and assimilated by the computer. Ideally, a magnetic tape system would supply or receive data from the machine fast enough so that the computer could proceed with the problem solution at its normal rate. In reality, however, the maximum rate at which information can be accommodated by a tape unit is usually very slow, compared to the speed of the machine, because of tape-speed limitations and the comparatively low density at which information is commonly stored on the tape. As a consequence, the bulk of problem-solution time is spent not in computation, as noted, but in the performance of input-output or tape storage operations. The investigation in Washington was directed at an improvement in tape-storage techniques to permit more rapid transmission of information to a computer, by increasing the number of pulses on each inch of the tape.

A variation of the non-return-to-zero (*NRZ*) system of tape recording was selected for the study. In this system, as ordinarily applied, current sufficient to saturate the tape is maintained in the recording head at all times, but the polarity is changed each time a binary *one* is to be recorded. When a binary zero is to be recorded, the current is not changed. This type of recording has been found to produce a single change in the magnetic flux on the tape for each binary one, and no change in flux for a zero; thus on playback a voltage is produced only when a *one* is read. Disadvantages of this method are that a continuous current must be maintained in the head during recording and that the polarity of the current must be switched rapidly. Unless center-tapped head windings are used, these requirements often lead to complicated driver circuits that consume considerable power. To overcome these drawbacks, scientists at the Bureau used a pulse technique, instead of the continuous-current method.

In the new approach, the recording rate and the exact location of each recorded digit is determined by timing pulses derived from a *sprocket* channel, prepared in advance of the recording operation. The word length can be chosen arbitrarily, depending on the equipment with which the storage system is to be used. If the number of digits per word is n, then the sprocket channel must provide $n + 1$ timing pulses per word. The extra pulse is used to set up a reference condition at the beginning of each word. In preparing the sprocket channel, it is also necessary to consider the speed and acceleration time of the tape drive, so that a sufficient gap can be left between words or groups of words for starting and stopping the tape, without missing information.

Starting with an erased tape, in the Washington system, sprocket pulses are recorded at the chosen rate along the entire length of the tape. These pulses must be counted, and the polarity of each recording pulse must be controlled. To illustrate, if information is to be recorded on the tape in words of n digits each, with a sufficient gap between words for starting and stopping the tape, then the sprocket channel must provide $n + 1$ timing pulses per word, and thus for $n + 1$ times the polarity of the pulses in the sprocket channel must alternate. After these $n + 1$ pulses have been recorded, a number of pulses of the same polarity is recorded to provide a gap of sufficient length. Since pulses of the same polarity recorded at a high enough density produce no change in tape polarization, there will be no playback signal from the gap. After the required number of like polarity pulses have been recorded, the polarity of the recording pulses then again alternate $n + 1$ times. The whole length of the sprocket channel is recorded in this manner, and the tape is then ready for use.

The Bureau's experts noted that in a tape storage system of this type, where a sprocket channel is used to interpret the playback signals from the information channels and to time the pulses recorded in the information channels, a problem arises from the close proximity of the read-record heads. During a recording operation, each timing pulse derived from the sprocket channel initiates a

(*Continued on page* 119)

J. E. SMITH
President
National Radio Institute
Washington, D.C.
40 years of success training men at home in spare time.

I Will Train You at Home
for Good Pay Jobs, Success in
RADIO-TELEVISION

Practice Broadcasting with Equipment I Send

It's practical to train at home for good Radio-TV jobs and a brighter future. As part of my Communications Course I send you kits of parts to build the low-power Broadcasting Transmitter shown at the left. You use it to get practical experience performing procedures demanded of Broadcasting Station Operators. An FCC Commercial Operator's License can be your ticket to a better job and a bright future; my Communications Course gives you the training you need to get your license. Mail card below and see in my book other valuable equipment you build. Get FREE sample lesson.

Practice Servicing with Equipment I Send

Self-confidence, security, earning power come from knowing-how and from experience. Nothing takes the place of PRACTICAL EXPERIENCE. That's why NRI training is based on LEARNING BY DOING. You use parts I furnish to build many circuits common to Radio and Television. With my Servicing Course you build a modern Radio (shown at right). You build a Multitester, use it in conducting experiments, fixing sets in spare time starting a few months after enrolling. All equipment is yours to keep. Card below will bring book showing other equipment you build. Judge for yourself whether you can learn at home in your spare time.

Television Is Growing Fast Making New Jobs, Prosperity

More than 30 million homes now have Television sets and thousands more are being sold every week. Well trained men are needed to make, install, service TV sets and to operate hundreds of Television stations. Think of the good job opportunities here for qualified technicians, operators, etc. If you're looking for opportunity, get started now learning Radio-Television at home in spare time. Cut out and mail postage-free card. J. E. Smith, President, National Radio Institute, Washington, D. C. Over 40 years' experience training men at home.

AVAILABLE TO VETERANS UNDER G.I. BILL

Good Jobs Good Pay **See Other Side**

Get My SAMPLE LESSON and 64-Page Illustrated Book BOTH FREE

Cut out and mail card NOW!

This card entitles you to Actual Lesson on Servicing, shows how you learn Radio-Television at home. You'll also receive my 64-page Book, "How to Be a Success in Radio-Television." Mail card now!

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Mr. J. E. SMITH, President
National Radio Institute, Washington 9, D. C.

Mail me Lesson and Book, "How to Be a Success in Radio-Television." (No Salesman will call. Please write plainly.)

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ADDRESS .....

CITY ..... ZONE ..... STATE .....

VETS write in date of discharge .....

Train at Home to Jump Your Pay as a RADIO-TV Technician

J. E. Smith, *President*
National Radio Institute

The men whose messages are published below were not born successful. Not so long ago they were doing exactly as you are now . . . reading my ad! They decided they should KNOW MORE . . . so they could EARN MORE . . . so they acted! Mail card below now.

Get a Better Job—Be Ready for a Brighter Future in America's Fast Growing Industry

Training PLUS opportunity is the PERFECT COMBINATION for job security, good pay, advancement. When times are good, the trained man makes the BETTER PAY, GETS PROMOTED. When jobs are scarce, the trained man enjoys GREATER SECURITY. NRI training can help assure more of the better things of life.

Radio-Television is today's opportunity field. Even without Television, Radio is bigger than ever before. Over 3,000 Radio Broadcasting Stations on the air; more than 115 million home and Automobile Radios are in use. Television Broadcast Stations extend from coast to coast now with over 30 million Television sets already in use. Over 400 Television stations are on the air and there are channels for hundreds more. Use of Aviation and Police Radio, Micro-Wave Relay, Two-way Radio communication for buses, taxis, trucks, etc., is expanding. New uses for Radio-Television principles coming in Industry, Government, Communications and Homes.

Start Soon to Make $10 to $15 a Week Extra Fixing Sets

Keep your job while training. Many NRI students make $10, $15 and more a week extra fixing neighbors' Radios in spare time, starting a few months after enrolling. The day you enroll I start sending you special booklets that show you how to fix sets. The multitester you build with parts I furnish helps discover and correct troubles.

SEE OTHER SIDE

My Training Is Up-to-Date You Learn by Doing

Get the benefit of our 40 years' experience training men. My well-illustrated lessons give you the basic principles you must have to assure continued success. Skillfully developed kits of parts I furnish "bring to life" the principles you learn from my lessons. Read more about equipment you get on other side of this page.

More and more Television information is being added to my courses. The equipment I furnish students gives experience on circuits common to BOTH Radio and Television.

Find Out About this Tested Way to Better Pay

Read at the right how fellows who acted to get the better things of life are making out now. Read how NRI students earn $10, $15 a week extra fixing Radios in spare time starting soon after enrolling. Read how my graduates start their own businesses. Then take the next step—mail card below.

You take absolutely no risk. I even pay postage. I want to put an Actual Lesson in your hands to prove NRI home training is practical, thorough. I want you to see my 64-page book, "How to Be a Success in Radio-Television," because it tells you about my 40 years of training men and important facts about present and future Radio-Television job opportunities. You can take NRI training for as little as $5 a month. Many graduates make more than the total cost of my training in two weeks. Mailing postage-free card can be an important step in becoming successful. J. E. Smith, President, National Radio Institute, Washington 9, D. C. Training Men for Over 40 years. Approved Member, National Home Study Council.

I Trained These Men

Lots of Spare-Time Jobs

"I do a lot of spare-time Radio and TV servicing. It was fun learning and I don't know how to thank you." B. Goede, Plainview, Minn.

Now TV Trouble Shooter

"I had only gone to 7th grade when I started course. Now have job as TV trouble shooter, also fix sets spare time." M. R. Lindemuth, Fort Wayne, Ind.

Engineer with WHPE

"Thanks to NRI, I operated a successful Radio repair store. Then I got a job with WPAQ and now am an engineer for WHPE." V. W. Workman, High Point, N. C.

NRI Course Can't Be Beat

"Am with WCOC. NRI Course can't be beat. No trouble passing 1st class Radiophone license examination." Jesse W. Parker, Meridian, Mississippi.

Quit Job for Own Business

"I decided to quit my job and do TV work full time. I love my work and am doing all right financially." William F. Kline, Cincinnati, Ohio.

Extra Money in Spare Time

"I am a police captain and also have good spare-time service business. Just opened my new showrooms and shop." C. W. Lewis, Pensacola, Fla.

My Training Leads to Jobs Like These

BROADCASTING: Chief Technician, Chief Operator, Power Monitor, Recording Operator, Remote Control Operator. **SERVICING:** Home and Auto Radios, P.A. Systems, Television Receivers, Electronic Controls, FM Radios. **IN RADIO PLANTS:** Design Assistant, Transmitter Design Technician, Service Manager, Tester, Servicemen, Research Assistant. **SHIP AND HARBOR RADIO:** Chief Operator, Assistant Operator, Radiotelephone Operator. **GOVERNMENT RADIO:** Operator in Army, Navy, Marine Corps, Coast Guard, Forestry Service Dispatcher, Airways Radio Operator. **AVIATION RADIO:** Plane Radio Operator, Transmitter Technician, Receiver Technician, Airport Transmitter Operator. **TELEVISION:** Pick-Up Operator, Voice Transmitter Operator, Television Technician, Remote Control Operator, Service and Maintenance Technician. **POLICE RADIO:** Transmitter Operator, Receiver Serviceman.

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CUT OUT AND MAIL POSTAGE-FREE CARD

Have Your Own Business

Many NRI trained men start their own successful Radio-Television sales and service business with capital earned in spare time. Joe Travers, a graduate of mine, in Asbury Park, N. J., writes: "I've come a long way in Radio and Television since graduating. Have my own business on Main Street."

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CBS TUBES ON THE

CBS TELEVISION

NETWORK

"Women! . . . bless 'em, catch on to *good* things fast. So I'm telling them on my Friday morning show . . . there are no better tubes made than CBS tubes . . . the tubes with the Good Housekeeping Guaranty Seal. *More and more women will be asking you for CBS tubes.*"

Garry Moore

Guaranteed by Good Housekeeping

Be sure YOU have CBS tubes in your tube caddy.

"I'll be on the CBS Television Network selling CBS tubes and your expert service every other Friday, 10:30 to 10:45 a.m., E.S.T."

CBS-HYTRON, Danvers, Massachusetts . . . A DIVISION OF COLUMBIA BROADCASTING SYSTEM, INC.

BLACK AND WHITE TV
COLOR TV
TRANSISTOR RADIOS
FM RADIOS
AM RADIOS
AMPLIFIERS AND TUNERS
AUTO RADIOS
RECORD CHANGERS

WHAT'S YOUR SERVICE PROBLEM?

PHOTOFACT HELPS YOU SOLVE IT

FASTER, EASIER, BETTER, MORE PROFITABLY!

THE WORLD'S FINEST SERVICE DATA

THESE GREAT FEATURES ARE EXCLUSIVE IN PHOTOFACT—THEY HELP YOU EARN MORE DAILY, HELP INSURE CUSTOMER SATISFACTION

PHOTOFACT Service Data is the *only* service information based upon first-hand examination of the actual production-run receivers and equipment. It is authentic, uniform data developed through actual study and analysis by service engineers in the Howard W. Sams Laboratories. PHOTOFACT is the *only data* prepared from the practical point of view of the Service Technician.

Thousands of Service Technicians use PHOTOFACT daily for time-saving, profit-boosting service operations. If you've never used PHOTOFACT, you've never realized your full earning power—you've never given such complete customer satisfaction. So get the proof for yourself. Try PHOTOFACT—use it on any job. Your Parts Distributor has the Folder Sets you need for any of the 17,000 TV and radio receivers, changers, recorders, etc., covered in PHOTOFACT. Once you use this great service, we know you'll want the complete PHOTOFACT Library.

FREE Send for the PHOTOFACT CUMULATIVE INDEX

IT'S VALUABLE!

Send for it! Your guide to virtually any model ever to come into your shop; helps you locate the proper PHOTOFACT Folder you need to solve any service problem on any model. Once you have the make and chassis number, it takes just 60 seconds to find the applicable PHOTOFACT Folder. Send coupon now for your FREE copy of the valuable Cumulative Index to all the PHOTOFACT Folders you need.

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Ask your PHOTOFACT Distributor . . . he'll show you how you can now own the PHOTOFACT Library through a unique Easy-Pay Plan that exactly fits your needs. Pays for itself as you EARN MORE.

FULL SCHEMATIC COVERAGE

1. Famous "Standard Notation" uniform symbols are used in every schematic.
2. The same standard, uniform layout is used for each schematic.
3. Diagrams are clear, large, easy to read, easy to handle.
4. Wave forms are shown right on the TV schematics for quick analysis by 'scope.
5. Voltages appear on the schematics for speedy voltage analysis.
6. Transformer lead color-coding is indicated on the schematic.
7. Transformer winding resistances appear on the schematic.
8. Schematics are keyed to photos and parts lists.

FULL PHOTOGRAPHIC COVERAGE

9. Exclusive photo coverage of all chassis views is provided for each receiver.
10. All parts are numbered and keyed to the schematic and parts lists.
11. Photo coverage provides quicker parts identifications and location.

ALIGNMENT INSTRUCTIONS

12. Complete, detailed alignment data is standard and uniformly presented in all Folders.
13. Alignment frequencies are shown on radio photos adjacent to adjustment number—adjustments are keyed to schematic and photos.

TUBE PLACEMENT CHARTS

14. Top and bottom views are shown. Top view is positioned as chassis would be viewed from back of cabinet.
15. Blank pin or locating key on each tube is shown on placement chart.
16. Tube charts include fuse location for quick service reference.

TUBE FAILURE CHECK CHARTS

17. Shows common trouble symptoms and indicates tubes generally responsible for such troubles.
18. Series filament strings are schematically presented for quick reference.

COMPLETE PARTS LISTS

19. A complete and detailed parts list is given for each receiver.
20. Proper replacement parts are listed, together with installation notes where required.
21. All parts are keyed to the photos and schematics for quick reference.

FIELD SERVICE NOTES

22. Each Folder includes time-saving tips for servicing in the customer's home.
23. Valuable hints are given for quick access to pertinent adjustments.
24. Tips on safety glass removal and cleaning.

TROUBLE-SHOOTING AIDS

25. Includes advice for localizing commonly recurring troubles.
26. Gives useful description of any new or unusual circuits employed in the receiver.
27. Includes hints and advice for each specific chassis.

OUTSTANDING GENERAL FEATURES

28. Each and every PHOTOFACT Folder, regardless of receiver manufacturer, is presented in a standard, uniform layout.
29. PHOTOFACT is a *current* service—you don't have to wait a year or longer for the data you need. PHOTOFACT keeps right up with receiver production.
30. PHOTOFACT gives you complete coverage on TV, Radio, Amplifiers, Tuners, Phonos, Changers.
31. PHOTOFACT maintains an inquiry service bureau for the benefit of its customers.

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ANNOUNCING THE

Trio Zephyr Royal

THE FIRST STAGGER-TUNED TELEVISION ANTENNA

What Hi-Fi brings to Audio
Stagger-tuning
brings to TV Antennas!

The ZEPHYR ROYAL employs three "wing" dipoles, stagger-tuned, to provide even higher and more uniform gain, absolute flat response on all channels 2–13—a necessity for color TV. It is tuned on six predetermined frequencies in the same way that stagger-tuned circuits are used in I.F. stages in TV receivers.

The ZEPHYR ROYAL is not just an addition to the famous TRIO ZEPHYR, but is a completely new electrical design. Parasitic elements are used ONLY where they contribute to the efficiency of the antenna's electrical design—not just for promotional purposes.

A new phasing method provides increased directivity—and functions equally well on the highs as well as the lows.

The elimination of minor lobes, to an extent never before realized in an all-channel antenna, finally banishes all co-channel interference. All of the gain is packed into one efficient forward lobe.

Try a new TRIO ZEPHYR ROYAL. You'll find that in gain and directivity it's the best all-channel TV antenna ever produced for color or black and white.

Pre-Assembled—Uses TRIO's famous Insta-Lok Clamps. Sturdy—Rugged—Compact and it's patented too!

MODEL ZR-1
$34.95 LIST

America's New Favorite

the Trio Zephyr

The antenna everyone's talking about! The ZEPHYR is a high performance, single lobe antenna, employing two revolutionary "wing" dipoles. Three half waves in phase, combined with an integrated director makes each dipole a unidirectional antenna on the high channels.

The ZEPHYR uses two "wing" dipoles, one resonated on the low ends of channels 2–6, and 7–13, the other on the high end of these channels. These composite dipoles, both driven, together with fully functional parasitics elements, produce the high performance to size ratio never before achieved in antenna design.

There's sharp directivity too, on all channels—comparable to a yagi.

TRIO believes that with the introduction of the ZEPHYR and the ZEPHYR ROYAL, the need for stacked arrays is eliminated.

TRIO Manufacturing Company
GRIGGSVILLE, ILLINOIS

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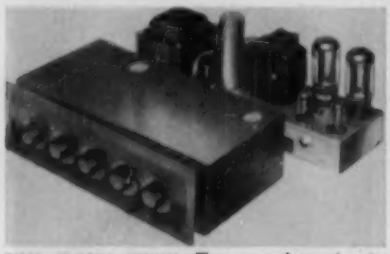
EXPORT SALES DIV., SCHEEL INTERNATIONAL INC., 4237 N. Lincoln Ave., Chicago, U.S.A. Cable Address: HARSCHEEL

Here's the new

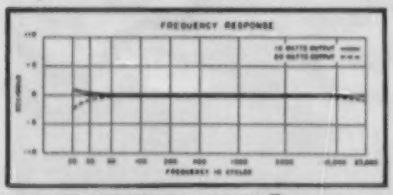
G-E CONVERTIBLE HI-FI AMPLIFIER

Pure 20-Watt Undistorted Output
Exclusive Dual Chassis Design

The exciting new *Convertible* is dramatic in performance—flexible in design. 20 watts of pure, undistorted output is only part of the *Convertible's* promise. Other new quality features include a 7-knob control panel, built-in rumble filter, 8-position selector/compensator, 5 inputs and 4 outputs for every audio need, and a power-on indicator pilot lamp. Truly, this remarkable instrument was designed for the most discriminating audio fan.



DUAL CHASSIS DESIGN. Two complete chassis function as one unit in a handsome metal cabinet . . . or may be custom-mounted separately.



20 WATTS UNDISTORTED OUTPUT. Frequency response curve is flat all the way out. ± 1 db 20 cps to 20 KC at 1/10 power and ± 2 db 30 cps to 15 KC at ½ power.

Listen to G.E.'s remarkable new Convertible at your hi-fi dealers'. Or, write: General Electric Co., Radio & TV Dept., Section R15125, Electronics Park, Syracuse, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC

Within the Industry

HOWARD W. SAMS has been elected chairman of the board of *Howard W. Sams & Co., Inc.* while J. A. Milling has been elevated to the post of president, succeeding Mr. Sams.

Mr. Sams has been president of the firm since he founded it in 1946 and Mr. Milling has been executive vice-president and general manager for the past three years.

The action of the board of directors was taken at Mr. Sams' request to permit him to devote more attention to long-range planning for the company. The new president was associated with *RCA* for twenty-four years before joining the *Sams* organization in 1952.

* * *

ATMO SEAL COMPANY has opened a modern plant in Cincinnati, Ohio for the manufacture of "fusion-sealed" terminals for the electronic and refrigeration industries. Principals of the new company were formerly executives of **FUSITE CORPORATION . . . WILLSON SALES COMPANY** has been formed as a manufacturers' representative firm with headquarters at 33 Maple Street, Malden, Mass. The organization will cover the entire New England territory . . . Thomas B. Aldrich, former sales manager of the **PRESTO RECORDING CORPORATION** has joined the **LEON L. ADELMAN CO.** firm to set up the **ADELMAN-ALDRICH** division which will handle industrial accounts. Offices will be maintained at 141 Broadway, New York City, and at Palisades, N. Y. . . . **FRANK R. COOK COMPANY, INC.** has been incorporated in Colorado and will engage in the development of equipment for the aeronautical and electronic industries. The company has completed negotiations for the purchase of laboratory and manufacturing facilities in Denver and in Colorado Springs.

* * *

RICHARD H. RANGER, president of *Rangertone,* Newark, N.J., has been elected president of the Audio Engineering Society for 1955-1956. He succeeds Albert A. Pulley of the *RCA Victor* Records Division.

Walter O. Stanton president of *Pickering and Company,* Oceanside, N. Y., was elected executive vice-president of the Society. Ewing D. Nunn, owner of *Audiophile Records,* Saukville, Wisconsin was named central vice-president while Roy A. Long, research engineer of the *Stanford Research Institute,* was chosen western vice-president.

C. J. LeBel, chief engineer of *Audio Instrument Co., Inc.,* a founder and first president of the Society, was re-elected secretary for his fifth consecutive term. The treasurer, Ralph A. Schlegel of *WOR-General Teleradio,* New York, was also renamed.

* * *

PHILIP A. PORTNOY has been elected vice-president of *Electronic Instrument Co., Inc.* of Brooklyn.

He has been with *Eico* since 1951 as executive assistant to President Harry Ashley, during which time he has made many contributions to the success of the business. Prior to that, he was a practicing attorney and, while in service during World War II, taught radar and radio electronics and repair at the Southern Signal Corps School in Florida.

* * *

INTERNATIONAL RESISTANCE COMPANY has begun construction of a modern, one-story building in Sylmar, Los Angeles County, California which will house three of its wholly-owned California subsidiary companies, **HYCOR, IRCAL INDUSTRIES,** and **EMEC, INC.** in addition to providing warehouse facilities for the parent firm on the West Coast. Occupancy is scheduled for mid-January . . . **HUDSON INDUSTRIAL ELECTRONICS CO., INC.** has moved its Industrial Sales operation to new quarters at 37 West 65th Street, New York 23, N.Y. The new location provides increased and improved warehousing and sales facilities . . . **UNITED TRANSFORMER CO.** has opened a Pacific Division plant at 4008 West Jefferson Boulevard in Los Angeles . . . **GENERAL CEMENT MFG. CO.** of Rockford, Illinois has consolidated all of its operations and those of five of its subsidiaries into a recently acquired five-story building at 400 S. Wyman Street, Rockford. The firm's chemical division will remain at the present site at 919 Taylor Ave. . . . **RCA** has completed arrangements to purchase an additional 285,000 square feet of building space in Lancaster, Pa., as part of its program for the accelerated production of color TV picture tubes. The firm now has more than a million square feet of space in Lancaster . . . **CALIFORNIA CHASSIS COMPANY** of Lynwood, Calif. has added approximately 10,000 square feet to its floor area with the erection

WANTED: 200,000 TV SERVICE MEN!

VETERANS
NON-VETERANS

GET IN ON THIS 2 BILLION DOLLAR PLUM!

200,000 — That's how many service men will be needed to handle television-radio-electronics industry requirements in the next few years. That's the figure given by the director of product service for CBS-Columbia — a man in a position to know.

2.7 billion dollars to be spent just for *service* and *installation* of TV sets in American homes by 1957! That's the figure given by one of the top men in the entire industry — the president of Radio Corporation of America.

J. C. Lane, B.S., M.A.
President, Radio-Television Training Association.
Executive Director, Pierce School of Radio & Television.

Think What This Means For YOU!

Here is a field still in its infancy — New jobs with top pay and a secure future are being created every day — Here is a chance for you to get into a growing field with unlimited opportunity for advancement — Here is your chance to set up your own business and be your own boss — Here is your opportunity to get in on a *2 billion dollar plum* by becoming a Television Technician.

VETERANS

Our School fully approved to train Veterans under new Korean G. I. Bill. Don't lose your school benefits by waiting too long. Write discharge date on coupon.

LEARN BY DOING

As part of your training, I give you the equipment you need to set up your own home laboratory and prepare for a BETTER PAY TV JOB. You build and keep a professional TV RECEIVER complete with big picture tube (designed and engineered to take any size up to 21-inch) . . . also a Super-Het Radio Receiver, AF-RF Signal Generator, Combination Voltmeter-Ammeter-Ohmmeter, C-W Telephone Transmitter, Public Address System, AC-DC Power Supply. Everything supplied, including all tubes.

EARN WHILE YOU LEARN

Almost from the very start of your course you can earn extra money by repairing sets for friends and neighbors. Many of my students earn up to $25 a week . . . pay for their entire training with spare time earnings . . . start their own profitable service business.

LEARN TELEVISION *AT HOME* IN YOUR *SPARE TIME*

Trained men get the top jobs. You can qualify for one without giving up your present job or social life. My lessons are especially prepared for you to study at home — even if you have absolutely no experience in this field.

CHOOSE FROM THREE COMPLETE COURSES
covering all phases of Radio, FM and TV

1. Radio, FM and Television Technician Course — no previous experience necessary.
2. FM-TV Technician Course — previous training or experience in radio required.
3. TV Cameraman and Studio Technician Course — advanced training for men with Radio or TV training or experience.

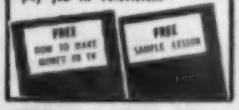
EXTRA TRAINING AT NO EXTRA COST

After you finish your home study training in Course 1 or 2 you can have two weeks, 50 hours, of intensive Lab work on modern electronic equipment at our associate resident school, Pierce School of Radio & Television. THIS EXTRA TRAINING IS YOURS AT NO EXTRA COST WHATSOEVER!

FCC COACHING COURSE — Important for BETTER-PAY JOBS requiring FCC License! You get this training AT NO EXTRA COST! Top TV jobs go to FCC-licensed technicians.

MAIL COUPON NOW!

I'll send you my new 48-page book, "How to Make Money in Television, Radio, Electronics," a Free sample lesson, and other literature showing how and where you can get a top-pay job in Television.



Mr. Leonard C. Lane, President
RADIO-TELEVISION TRAINING ASSOCIATION
Dept. T-12C, 52 East 19th Street, New York 3, N. Y.

Dear Mr. Lane: Mail me your NEW FREE BOOK, FREE SAMPLE LESSON, and FREE aids that will show me how I can make BIG MONEY IN TELEVISION. I understand I am under no obligation and no salesman will call.

(PLEASE PRINT PLAINLY)

Name_____ Age_____

Address_____

City_____ Zone____ State_____

I AM INTERESTED IN:
- ☐ Radio-FM-TV Technician Course
- ☐ FM-TV Technician Course
- ☐ TV Cameraman & Studio Technician Course

VETERANS! Write discharge date

MAIL THIS COUPON TODAY!
NO SALESMAN WILL CALL!

Radio Television Training Association

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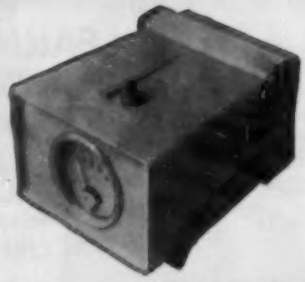

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of an annex immediately adjoining and connected with its main plant at 5445 Century Blvd. The new building will be used for research and warehousing . . . **TELECTROSONIC CORPORATION** has added another floor to its plant at 35-16 37th St., Long Island City 1, New York which increases production area by more than 25 per-cent . . . **ELECTRICAL SUPPLY CORPORATION**, New England jobber firm, has moved to new quarters at 205 Alewife Brook Parkway, Cambridge, Mass. The new building provides almost four times the space of the firm's former location in central Cambridge . . . The Canadian division of **AMPEX AMERICAN** has opened its first office at 70 Grenville Street, Toronto. The division will serve as a sales and distribution point for the firm's line of magnetic recording equipment . . . **VARIAN ASSOCIATES** is adding two new wings to its Palo Alto, California plant which will add 25,000 square feet of work area . . . **EECO PRODUCTION COMPANY** has opened a new plant at 506 East First Street, Santa Ana . . . **ADMIRAL CORPORATION** has broken ground for a new electronic research laboratory to be situated on a three-acre site in Stanford Industrial Park. The site is at California Avenue and Cornell Streets in Palo Alto, California.

* * *

JOHN V. L. HOGAN, president of *Hogan Laboratories* and founder of station WQXR, has been named recipient of the IRE "Medal of Honor," the highest technical award in the radio engineering profession.

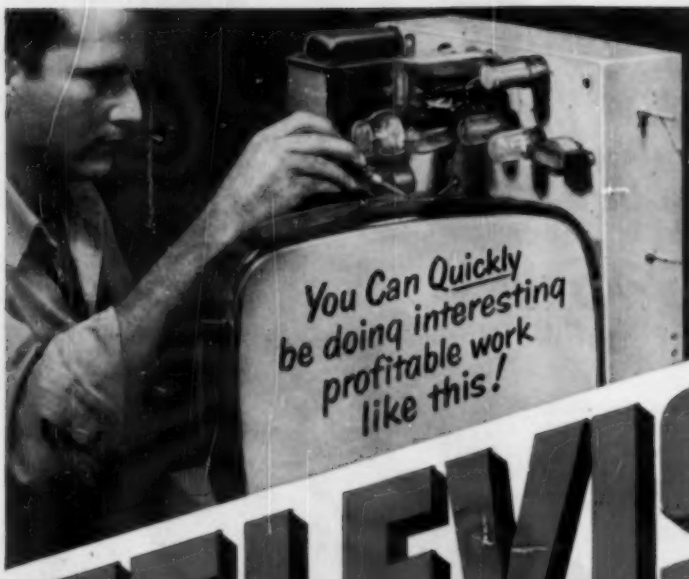
The award, which was given "For his contributions to the electronic field as a founder and builder of The Institute of Radio Engineers, for the long sequence of his inventions, and for his continuing activity in the development of devices and systems useful in the communications art," will be presented during the IRE National Convention in New York City next March.

He helped to found the IRE in 1912 and has served as president and vice-president of the association and on the board of directors and on many committees over the years.

* * *

JOSEPH P. BANNON has been appointed general sales manager of the *RCA Victor Television Division*. He was formerly field sales manager of the division . . . *The Rust Industrial Company, Inc.* of Manchester, N. H. has named **WILLIAM J. BARKLEY** to the post of vice-president. He has been in the radio and "wireless" fields since 1907 and was formerly associated with **DR. LEE DE FOREST** as vice-president of the *De Forest Radio Co.* . . . **JOSEPH SOLARI** is the new general sales manager of the components division of *Federal Telephone and Radio Company* of Clifton, N. J. . . . **ROBERT L. S. LEEDY** has

(*Continued on page* 130)



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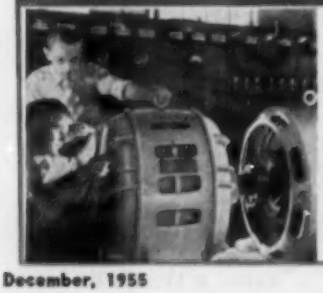

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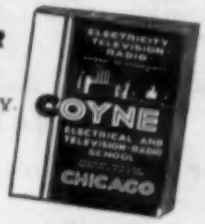

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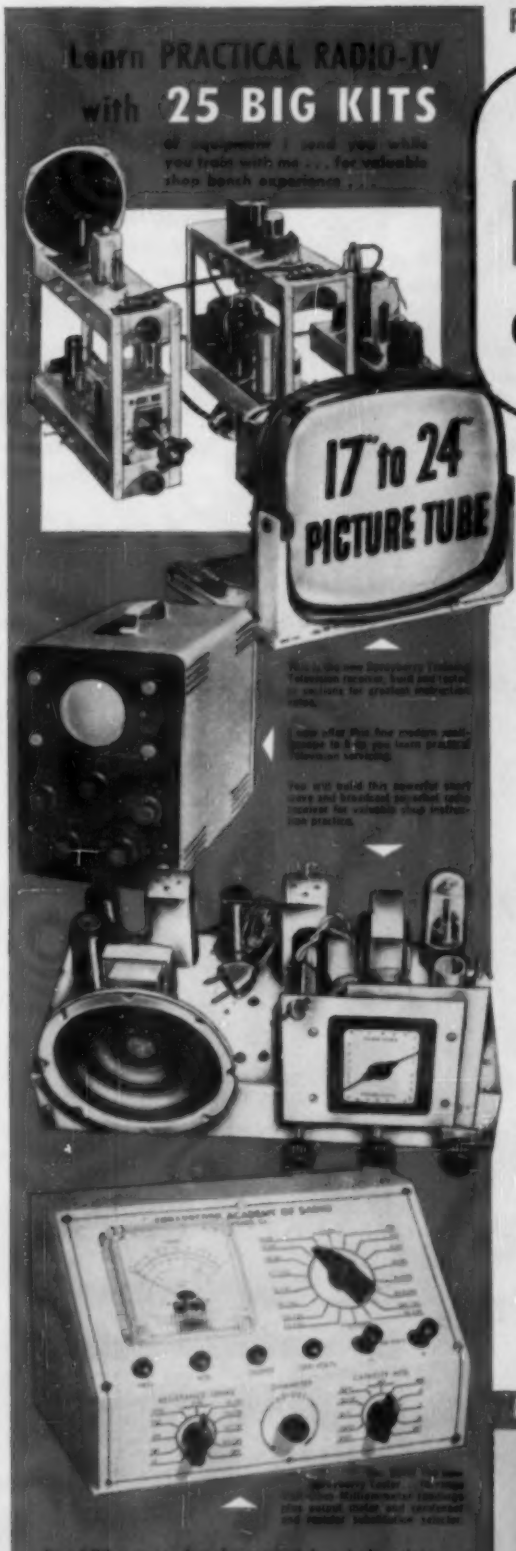

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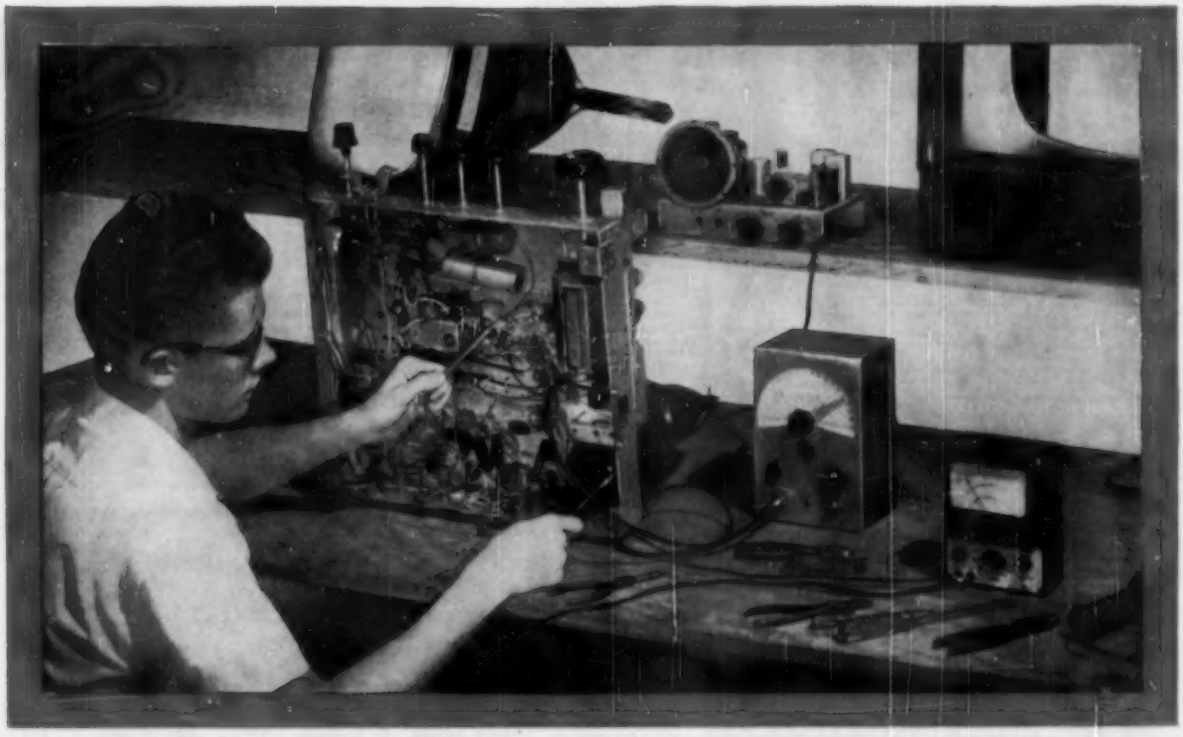

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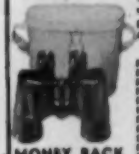

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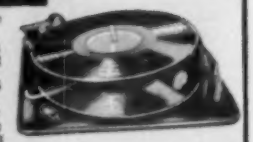

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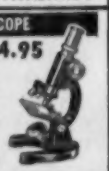

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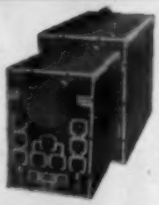

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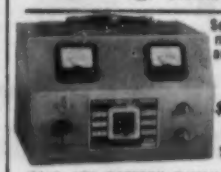

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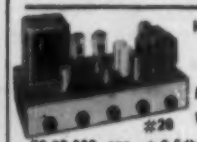

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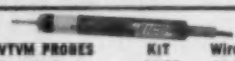

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Color TV Today

Shown here are the 2076 parts which comprise the 21-inch RCA color television receiver. In the background is the complete consolette.

More color telecasting and greater production of color TV receivers promised in 1956, but how do we stand today?

By **MILTON S. KIVER***

THE subject of color television, brought up in any gathering of engineers or laymen, always evokes considerable comment. Yet in spite of this obvious interest, and in spite of the fact that we live in an age of production miracles, color television receivers have appeared only in token quantities. It has been estimated that the public owns no more than 30,000 such receivers—this fully two years after the FCC gave its official blessing to the NTSC compatible color television system and after set manufacturers have initiated extensive sales campaigns and exhibited numerous models.

What has been happening to color and what are the reasons behind the limited distribution of sets? The initial sets, which appeared in 1954, employed 12-inch picture tubes and were priced somewhere in the neighborhood of $1000. Today we have 21-inch color picture tubes and a lot fewer tubes in the receiver and the average price tag is around $800. From one point of view, the enlargement of the picture tube from 12 to 21 inches can be considered as excellent progress. The rub, however, lies in the $800 price tag; this is still far from the range where extensive customer buying will take place.

The Price Factor

Black-and-white television receivers, of good quality, can be purchased for between $200 and $300. Furthermore, well over 95 per-cent of all of today's programming is in black-and-white, so the inducement to purchase a color set is further reduced. Industry spokesmen are pretty well agreed that with more color programs and cheaper color sets, the public would buy and in substantial quantity. Of these two factors, it is the price of the color set which is perhaps the most important.

Present color television receivers have between 26 and 28 tubes. This is not an excessive number when compared to black-and-white receivers and so only a small part of the higher cost of a color receiver is due to the number of its tubes and to the additional complexity of its circuits. The rest of the answer, then, must be found in one other place: the picture tube. This is a 3-gun affair with a fairly intricate shadow mask and phosphor screen arrangement, and the production expenses are such that the tube costs the receiver manufacturer around $125. When normal handling and distribution costs are added to this, the price to the customer is in the neighborhood of $250 or more. If we compare this cost with that which a set manufacturer pays for a comparable black-and-white picture tube (about $18), some of the reasons for the present high cost of color television receivers becomes understandable.

The obvious solution, of course, is to design a lower cost tube. Some of the finest research engineers have been working on this problem for several years and the present 21-inch tri-gun color tube is the best they have been able to produce. Several manufacturers are known to be working on one-gun color picture tubes, but thus far they have apparently not been able to produce a tube which can offer any serious competition to the 3-gun tube. The single-gun Lawrence tube, a product of the *Chromatic Television Laboratories*, has made several public appearances but thus far the industry has not been able to develop much enthusiasm for it. At one time *Crosley* announced that it was setting up a complete plant to manufacture this particular tube, but for some unpublicized reason, the project was dropped.

While progress in producing a large-screen, low-cost picture tube has been at a snail's pace, the advance on the circuit front has been quite spectacular. The number of tubes in the first color receiver was close to 40. Then the *RCA* license laboratory came out with a 28-tube design that produced a good color picture. More recently, the receiver division of *RCA* has further modified this circuit so that only 26 tubes are needed and that is where the situation stands at present. (It may be that the number of tubes will be reduced further to 23 or 24, but this is not too significant. The true objective is not tube reduction *per se*, but tube reduction without impairment of quality. From all present indications, we are close to the point where quality may be threatened unless special type

* Author of "Color Television Fundamentals," McGraw-Hill Book Company, Inc.

multipurpose tubes are developed and made available soon.)

All of the new receivers show a trend to *R-Y, B-Y* or narrow-band color systems. This is in contrast to *I, Q* receivers where the full color capabilities of the transmitted signal are utilized. The underlying reason for this shift is tied in solely with economics. The narrow-band receivers are cheaper to build. If the color pictures produced by both systems are compared side by side, then the lack of color fidelity of *R-Y, B-Y* sets becomes noticeable. However, from a practical standpoint, such comparison tests are never made in the home and the color picture of a narrow-band system proves satisfactory. It may be that when other costs, such as the tube, for example, become more manageable, that more *I, Q* sets will be built. But as of now, narrow-band sets predominate.

Those readers who have been fortunate enough to view color broadcasts on a well designed and properly adjusted color receiver (using either system) can understand why so much money and effort are being expended to evolve an economical commercial receiver. Here is not just another "gimmick" designed solely to spur sales with no real, intrinsic value behind it. On the contrary, here is something which, when added to a television picture, greatly enhances the viewer's enjoyment of that image. Perhaps the basic appeal of a colored image lies in its greater naturalness. We live in an environment that contains many varieties of color and to desire the same life-like qualities in television is quite understandable. Furthermore, color in an image heightens the contrast between elements, brightens the highlights, deepens the shadows, and appears to add a third dimension to an otherwise flat reproduction. It is interesting to note that more detail appears to be present in colored images containing fewer lines than corresponding black-and-white pictures. These remarkable differences are apparent between color motion films and ordinary motion pictures. Similar differences are observed with television.

Color Set Controls

Operation of a color television receiver by the average set user is not much more difficult than operation of a black-and-white receiver. The familiar controls of station selector, fine tuning, brightness, contrast, "on-off" switch, and volume are used in color receivers, performing the same functions they do in monochrome receivers. In addition, vertical and horizontal hold controls and perhaps a focus control may be hidden behind a hinged front plate. Again, function remains unaltered because essentially similar circuits are being employed in both types of receivers.

Two new controls that the set user will encounter in a color receiver stem directly from the presence of color in the image. One control is called "color intensity" and the other is "color shading." (Alternate names for these two controls are "chroma" and "hue.") The color intensity or chroma control regulates the amount of color signal reaching the screen and hence determines the saturation with which colors are seen. In action it may be compared to the familiar contrast control; note, however, that there is usually a master contrast control that regulates the intensity of both the monochrome and color portions of the image simultaneously. The chroma control might be considered as an adjunct to this master contrast control, concerned only with the color portion of the picture. The color shading, hue, or color fidelity control enables the viewer, within a limited range, to alter colors observed on the screen. As the control is rotated, red may change to yellow, green to blue, and blue to magenta or red. If the various color circuits in the receiver are functioning normally, then some point should be found over the range of this control where the observed colors possess the proper hue. Probably the best reference to use is the color of a person's skin. In the absence of this reference, any familiar object, such as a yellow banana or a red apple, may be employed.

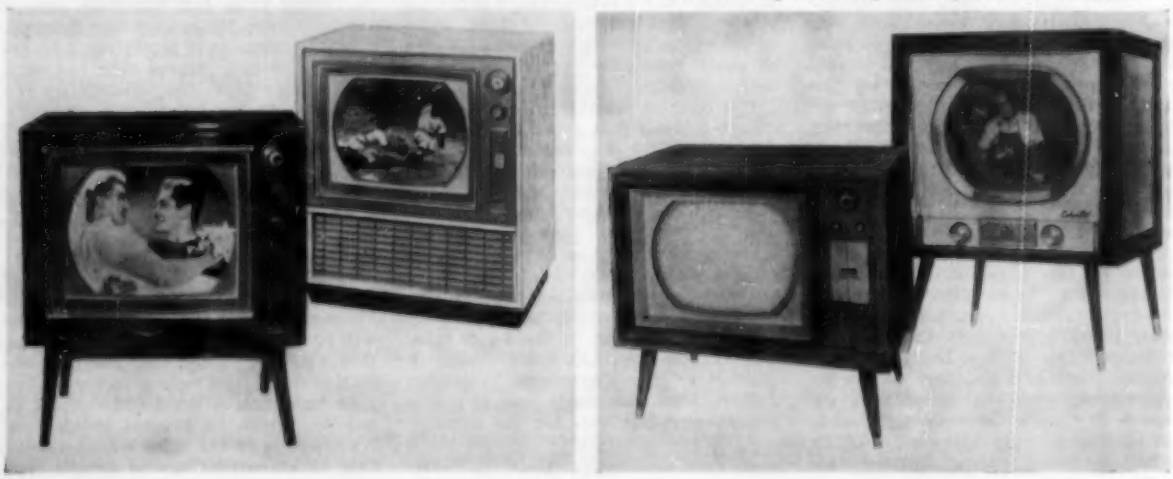
The one precaution that must be carefully observed is in the adjustment of the fine-tuning control. The importance of adjusting this control correctly must be fully impressed upon the lay set user because it frequently takes no more than a 5 to 10 degree rotation of this control from its proper setting to kill the color in the picture. The technical reason for this behavior stems from the fact that the single most important segment of an incoming color signal is the color sync burst, and incorrect positioning of the fine-tuning control can cause enough sync burst attenuation to prevent opening up of the chrominance sections of the receiver: result—no color, only black and white.

Typical of the tuning instructions which come with a color receiver are the following. As a first step, tune in the signal just as for a black-and-white broadcast. Then advance the color saturation control approximately two-thirds from its maximum counterclockwise position. Then carefully advance the fine-tuning control clockwise until the picture just begins to disappear; next, turn counterclockwise slowly to the position where the sound bars just disappear and color is in the picture. The final two steps then involve touch up adjustments of the color saturation and hue controls for pleasing color.

The year 1955 is drawing to a close and the production of color receivers has been anything but spectacular. For the coming year, 1956, most receiver manufacturers are cautiously optimistic.* All foresee increasing production and a continuing trend toward lower

* Information in this section was obtained from private sources and from answers to a questionnaire that was sent to a number of receiver manufacturers. Responses to the questionnaire were received from the following set manufacturers (in alphabetical order): *Andrea, Bendix, Crosley, Emerson, Hoffman, Magnavox, Motorola, Packard-Bell, Philco, RCA, and Zenith.* The author and the editors of Radio & Television News would like to express their thanks to these firms for their cooperation.

Some commercial large screen color TV sets available now. Represented are models by RCA, Magnavox, Sparton, and Motorola.



prices. But very few will go on record either to estimate their own production, or how much lower the prices will be, or even how fast they will descend. A lot depends on the price of the color picture tube. At the moment, the prices of existing receivers range from $695 on up. The lower figure is for the *Motorola* Model 19CT1 which possesses 28 tubes and uses the *CBS-Hytron* "205" color tube (a 19-inch screen). The circuit is essentially the same as that described in the January and February, 1955 issues of RADIO & TELEVISION NEWS.

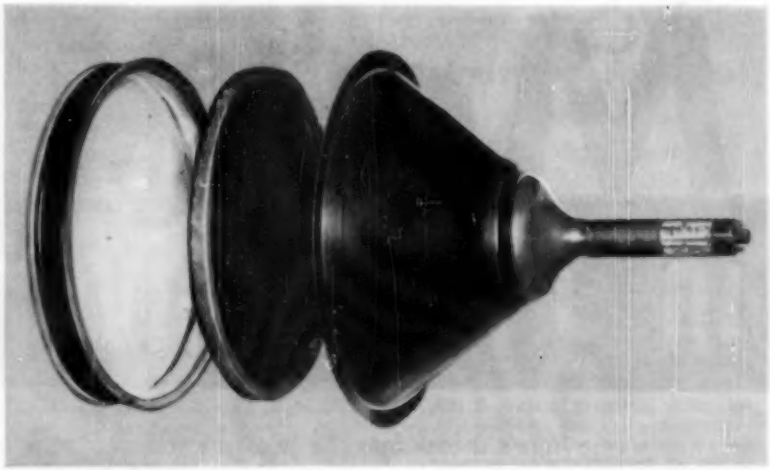
Many manufacturers will market either the *RCA* 26-tube receiver described in the March, 1955 issue or modified versions of it. *RCA* has the receiver available in two models: the "Director" (Model 21CT-662) in an open-face console for $895 and the "Seville" (Model 21CT-661) in a low-boy consolette for a nationally-advertised price of $795.

An interesting development that closely parallels a situation that existed in black-and-white television in 1946 is the statement by *Magnavox* officials that *RCA* will produce *Magnavox's* first color receivers. (At that time, *RCA* "private-labelled" the 630 for a number of manufacturers.) Since volume production is not expected, *Magnavox* feels that by using the existing facilities at *RCA*, a greater savings can be achieved than if *Magnavox* itself undertook to produce these first sets. Furthermore, arrangements have been made with the *RCA Service Company* to service all such receivers made for *Magnavox* on the same basis as for *RCA* color sets. This arrangement will continue until *Magnavox* dealers can be provided with the necessary expertly-trained service personnel.

Although *Magnavox* is the only company that has publicly announced such a policy, it is known that other companies are considering a similar arrangement. This solution offers an easy entree into the color television field until such time as sales warrant full scale production for the smaller companies.

There are some manufacturers, like *Zenith* and *Du Mont*, who state quite definitely that they do not feel color television receivers are ready for mass production at this time. In the words of Leonard C. Truesdell, *Zenith* vice-president in charge of sales, "We do not plan to mass produce color television receivers this year (1955). Our engineering and development work is going forward at full speed, but it is our opinion that color television receivers and especially color tubes are not ready for mass production or for mass distribution."

Philco has announced that it is going ahead with the production of a color receiver using the 3-gun color tube. In view of the known fact that *Philco* is working on a 1-gun tube, the inference can be drawn that enough progress has not been made on this tube to warrant a competitive commercial receiver at this time. In the future, perhaps 1956 or 1957, a low-cost 1-gun tube may be developed and then the over-all picture can change significantly.



Exploded view of the RCA 21AXP22 three-gun color picture tube in actual production at the present time. This tube uses a spherical shadow mask and a metal envelope.

Andrea, Bendix, Packard-Bell, Hoffman, Emerson, and several other manufacturers have definitely announced color sets containing from 26 to 28 tubes and priced from $700 to $900. If any appreciable sales develop, the rush to climb aboard the bandwagon will spread like fire in a dry forest.

Servicing

Now a word to the service industry. The arrival of color receivers in quantity will certainly increase yearly volume by a considerable amount. But to adequately take care of this new business, the individual service technician will have to do two things: familiarize himself with color television fundamentals and add to his present complement of service instruments. Of prime importance to color receiver repair is the color-bar generator. This is an instrument which develops color signals for use in the servicing and alignment of color receivers. In service, for example, a color-bar generator can be put to a variety of uses, from an evaluation of the over-all behavior and color fidelity of a receiver to a stage-by-stage analysis of either the luminance or chrominance sections. In adjustment and alignment, use of a known color signal quickly enables the technician to determine whether a circuit or section is in adjustment and, if not, when this condition is attained in subsequent alignment.

The next question, of course, is: "How much will these new generators cost?" There are a number of color-bar generators presently available and all of these fall into one of two categories. There are those generators which will develop test signals that conform to the NTSC (National Television Systems Committee) standards for color signals. Into this group would go such generators as the *Hickok* Model 655XC, the *Jackson* Models 710 and 712, and the *Hycon* Model 616 color-bar generators. These units offer extensive test facilities and range in price from $250 to $600. Then there is a group of color-bar generators which will develop color patterns on a receiver screen, but the signals they produce do not conform to NTSC standards. This latter group of instruments is frequently called "rainbow" generators because the colors they develop range in sequence from one end of the spectrum to the other. Into this category fall such instruments as the *Wintronix* Model 150, the *RCA* Model WR-61A generator, and the *Triplett* Model 3439. Prices in this group range from $50 to several hundred dollars.

Also important to the well-equipped service shop is a white-dot generator (for picture tube convergence adjustments) and a wide-band oscilloscope (for inspection of the color video signal, particularly the 3.58 mc. color burst.) White-dot generators may be purchased separately (average price about $100) or may be obtained as part of the color-bar generator. Wide-band oscilloscopes, with vertical system responses to 4 mc. and above, are more expensive items, starting around $200 and ranging up to $500 or more.

In short, the service technician will have to spend between $350 and $900 to equip himself with the additional instruments required to adequately repair color television receivers. To forego these expenditures is to ignore progress, a course of action without a future.

In spite of the limited production that has been realized to date, the entire industry foresees a rosy future for color television. In a recent speech, Paul V. Galvin, president and chairman of *Motorola*, predicted that by 1955 there will be 65 million TV sets in use, of which more than half will be color sets. If this prediction does come true, the immediate years ahead will indeed be busy ones. —30—

Modules in TV Receiver Design

Here's a look into the television receiver that is coming soon, bringing with it circuit standardization and service problems.

THE application of automatic component assembly to TV production requires a number of new machines. Because of the large investment in machinery required, most of the medium sized TV manufacturers have hesitated to switch to automatic assembly systems. Now it appears that a solution to the automation problem is at hand which will permit even the small TV makers to get all the advantages of low assembly cost.

A few years ago, the National Bureau of Standards developed the modular assembly system under the title of "Project Tinkertoy," intended primarily for standardized military electronic equipment. At the time this system was demonstrated to the TV industry there seemed little likelihood that it would be used in TV receivers. Now, at least, two private concerns, the *Aerovox Corporation* and *ACF Electronics, Inc.*, are producing modules especially designed for TV receivers and a number of important TV manufacturers are planning to use these modules. It is expected that in the near future a large percentage of new sets will contain modules, requiring a new approach in servicing.

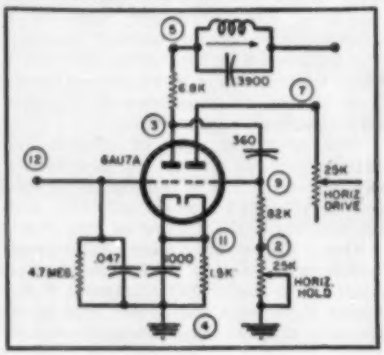
This article will acquaint our readers with the various aspects of module assembly and will also present some information on servicing modular-type TV sets.

The Module Assembly

The principle of the module system lies in the automatic production of a notched ceramic wafer, typical examples of which are shown in Fig. 3. The conducting material on these wafers is a silver coating applied around the notches and on the wafer itself. By applying silver material to both sides of a wafer, a capacitor can be formed, by applying a resistive silver paste a resistor is created, and by depositing a silver spiral pattern an inductance can be formed. Actually, most of the standard wafers contain more than one component, usually one or two flat resistors, one or two capacitors (ceramic, glass, or film type), and coils wound in a flat pie pattern. The great economy in production stems from the fact that each wafer can be automatically assembled, tested, and stacked with from five to six other wafers into a module. Connections between wafers are made by means of twelve "risers" or wire bus bars which also connect to the printed wiring baseboard and to the tube socket. The entire production, from the mixing of the chemicals needed to form the ceramic wafers to the final coating with an insulating material is accomplished by machines. This production process includes 100% automatic testing of each wafer and each module.

Fig. 4 shows a number of typical individual wafers prior to assembly into a module. Note how the capacitors are simply soldered to the wafer without insulation. The two tape-type resistors on some of the wafers could be connected in parallel to obtain greater power rating, or in series for added resistance. Sometimes a wafer is merely used to interconnect several of the twelve risers.

Fig. 1. Schematic diagram of the horizontal oscillator of the modular TV receiver. All parts, with the exception of the drive control, hold control, and the oscillator coil assembly, are contained on a single module such as in Fig. 5.



A module consisting of a stack of wafers is shown in Fig. 5, prior to being impregnated with a dust- and moisture-proofing compound. Fig. 7 shows a typical completed module and next to it the conventional parts it replaces.

In general, modules are used only with miniature 7- and 9-pin tubes and with voltages up to 600 volts d.c. Resistors which are part of the module assembly are the paste or carbon type with resistances from 5 ohms to 10 megohms, in ½, 1, and 2 watt ratings. Tolerances of 5, 10, and 20% are available. Ceramic capacitors are supplied in three ranges, 10-150 $\mu\mu$fd. (10%), 10-2200 $\mu\mu$fd. (20%), and 2200-10,000 $\mu\mu$fd. (+50%, −0%), all with 500 volt d.c. ratings. Capacitors using glass dielectric are also used in values from 1 to 10,000 $\mu\mu$fd. in either 300 or 600 volt d.c. ratings with 10% tolerance. For the higher capacity ratings there are plastic film types, similar in ratings and values to the conventional paper tubulars. The coils used in modules are usually of the single pie type ranging in inductance from 0.25 microhenry to 10 millihenrys.

While the service technician should be familiar with the limitations of the module system as far as components are concerned, he will probably not have the opportunity to replace a component by itself. As will be shown later, the minimum replacement item will be a complete module rather than the individual component.

Servicing the module-type TV receiver requires a knowledge of the sections in the receiver in which the module operates. An explanation of how modules are used in a receiver should be helpful.

Modular TV Receiver

The prime requisite for widespread use of modules is standardized TV circuitry. Indeed, there is now a definite trend towards a more uniform circuitry even among the conventionally-assembled receivers. When many of the TV set manufacturers buy com-

By
WALTER H. BUCHSBAUM
Television Consultant
RADIO & TELEVISION NEWS

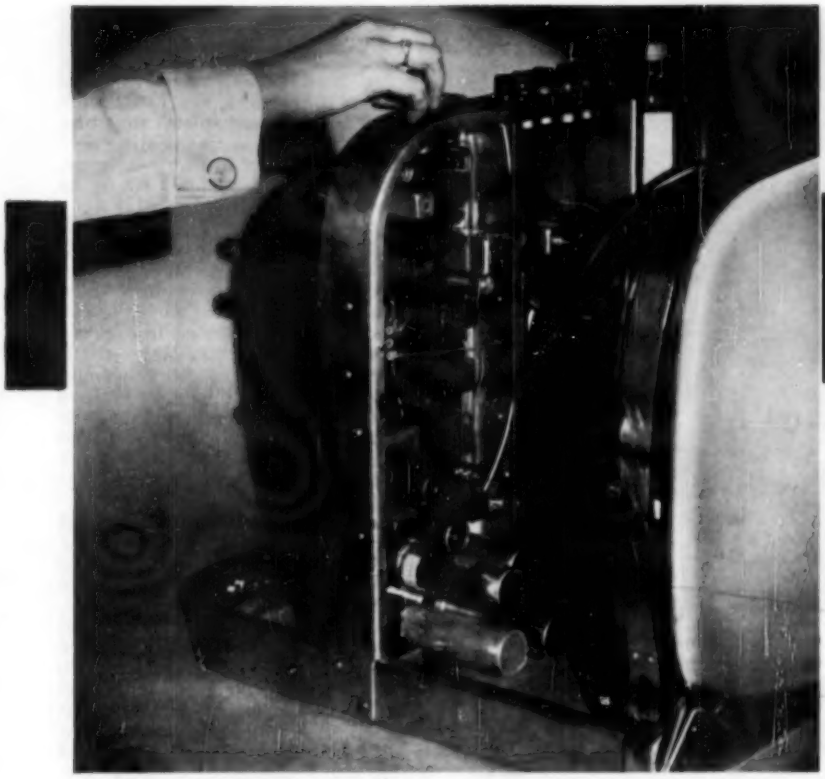


Fig. 2. Front view of an experimental model of a TV receiver using modules, designed by ACF Electronics. Of the 195 components comprising this set, 153 parts are embodied in the 17 modules. The remaining parts are transformers, electrolytic capacitors, power resistors, tunable components, and the r.f. tuner.

plete modules from their component suppliers, the circuits of different TV models will become practically identical. The stock problem for the service technician and his distributor will also be greatly reduced. In place of some 300 different parts for a particular set, only 10 or 12 standard modules plus a few rectifiers, tubes, and transformers will be needed.

Figs. 2 and 6 show the front and rear of an experimental module TV receiver. This set uses a vertical chassis with tubes facing to the rear and all controls mounted on the top supporting flange. As shown in Fig. 6, the set uses a total of 16 modules, two of which have no tubes associated with them. A different experimental TV set contains only 13 modules. In either instance, only the tuner and flyback section do not contain any modules.

All modules are mounted on an etched circuit panel which provides the interconnections and also mounts additional parts. For example, in the set shown in Figs. 2 and 6, the i.f. coils are separate variable coils of conventional construction, mounted between modules on the etched circuit board. Similarly, the electrolytic capacitors are mounted directly on the board. The entire printed circuit subassembly is dip soldered and mounted on the main frame.

Fig. 1 shows the circuit of one of the modules of the experimental TV set shown in Figs. 2 and 6. This set uses a turret tuner, 3-stage 41 mc. i.f., intercarrier sound, keyed a.g.c., and a phase detector type a.f.c. in the horizontal oscillator section. Series heaters and a selenium rectifier doubler-type power supply are used. None of the circuit features is novel.

The module whose diagram is shown in Fig. 1 comprises the horizontal oscillator. This module replaces 7 individual components and a 9-pin tube socket. The horizontal oscillator coil

Fig. 3. Typical individual wafers before stacking and impregnation, are shown here. The wafer on the left contains two strip resistors; the one on the right, an inductance. The wafer in the center is used merely to connect two parts of the circuit and hence, contains only a strip of silver conductor.

is a conventional slug-tuned coil, mounted on the etched wiring board right next to the module. Similarly, the hold and drive controls are mounted on the wiring board and connected to the module through the "risers." The numbers circled on the schematic diagram correspond to the electrical connections of the "risers" in this module. The entire module is supported by the "risers" which also mount the module in the circuit board. Not all the "risers" are connected into the circuit, which is why some numbers are skipped. In production, the individual modules and other components are mounted on the board and then the entire board is dip soldered. This means that removal of an individual module would require unsoldering all 12 "risers" simultaneously. A different replacement method is outlined below.

Servicing

When servicing modular TV receivers greater emphasis will be placed on localizing defects to particular stages rather than looking for the defective component itself. New troubleshooting methods and a number of novel servicing aids may result from the change to modular construction.

Assume that the defect in a modular TV set is unstable vertical hold. This may normally be due to failure in the vertical sync pulse integrating network, the vertical oscillator, or the sync separator section. After substituting good tubes for the vertical

Fig. 4. Shown here are all the individual wafers contained in one typical module. The wafer on the right will hold a 9-pin miniature tube socket.

Fig. 5. Typical module before impregnation with insulating type substance.

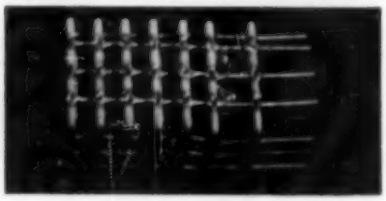


Fig. 6. Rear view of the ACF Electronics TV receiver. Note the use of the printed wiring board for the entire circuit except for the tuner and high voltage portion.

oscillator and the sync separator, the next logical step would be to observe, on the scope, the video signal as it goes to the sync separator grid, then the vertical pulse after integration, and finally, the waveform at the grid of the vertical oscillator tube. The first and last of these test points are readily available at the tube pins or the "risers" from the respective modules. If the oscilloscope test indicates that the vertical sync pulse is either weak or lost entirely in the sync separator module, the entire module must be replaced.

Before the new module is connected into the circuit, connections from the old module may be brought out to it by means of clip leads. If this cures the defect, the need for replacing the original module has been definitely proven. This method is more difficult to use in the case of i.f. stages where lead lengths are critical. In most instances it will be possible to isolate defects in the i.f. section by checking the output of each stage, going from the tuner down to the video detector. To get enough signal for the oscilloscope presentation an r.f. sweep generator is connected to the antenna terminals and then the 60 cps sweep signal, showing the response characteristic, is detected by means of a crystal diode probe. This method permits accurate troubleshooting of the entire i.f. section of a modular receiver, just as it does for conventional sets.

It is possible to make connections to most points in the module network by scraping the protective coating from the desired "riser." This is not recommended, however, since it may result in damage to the rest of the module, either by accidental scraping or by eventually resulting in peeling of portions of the impregnating material.

Once the modular-type receiver becomes common, service technicians will stock replacement modules of every type to make substitution a rather simple and quick affair.

As was mentioned before, the individual module is held onto the printed wiring board by means of the 12 "risers" which are soldered into mating holes. These holes are usually plated through the board and are part of the electrical network as well as a mechanical mount. Where less than 12 electrical connections are used, some of the "risers" and their mounting holes serve only as mechanical support for the module but in every instance, all 12 "risers" are soldered firmly to the printed wiring board.

Removing the module without harming the printed wiring board is not as difficult as it may appear. First cut all "risers" close to the wafer which butts against the printed wiring board. Then apply a hot soldering iron to the first "riser" where it has been cut off. At the same time, grip the other end of the "riser" with long-nosed pliers and pull the wire gently through the hole. In this manner each of the "risers" can be removed without damage to the printed wiring board. The original module however is destroyed.

Before replacing the defective unit with a good module, the mounting holes for all 12 "risers" must be cleared of solder. After applying a small soldering iron to heat each joint, a thin steel probe can be used to push the solder out. When all 12 holes are clear, the new module is jiggled into place. Do not solder any connections until the circuit is tested out. Bending each "riser" so that it makes contact with its corresponding printed wiring board connection is usually sufficient to make good contact for a test run. Only after the new module is proven to have cured the defect are the risers soldered into place.

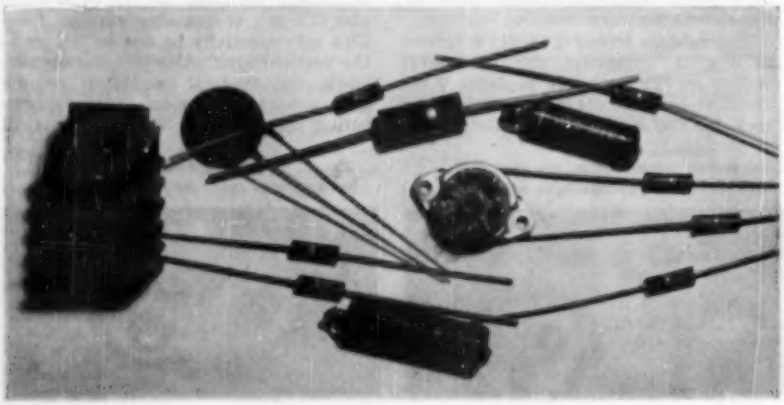
At this point it may be appropriate to mention a few facts about soldering to printed wiring in general. Always use a small tip soldering iron. Be extra sure the tip is clean, smooth, and properly tinned. Use the right kind of solder, as recommended by the manufacturer. Never use acid or corrosive fluxes. Never squeeze or scrape the metal foil on printed wiring in order to make the solder run or hold better. Whenever a wire connects to the metal foil, put the soldering iron tip on the wire rather than the foil and wait until the solder flows smoothly from the wire to the foil so that it completely surrounds the wire and fills the hole.

In handling modules it becomes apparent that although these units look fragile, they are very sturdy and will resist scraping and chipping quite well. This does not mean that a TV subchassis, such as the printed wiring assembly, should be rested on the modules while work is being done on it. Nor should individual modules be handled roughly or stored unwrapped.

There will probably be less circuitry trouble in modular receivers than in conventional sets, and individual modules will rarely need replacement. Certainly the troubleshooting of such receivers will be greatly simplified once the service technician becomes familiar with the function of each module and its contribution to over-all receiver performance.

—30—

Fig. 7. The completed module on the left replaces all of the parts shown on right.



FACTS TO KNOW

By **N. H. CROWHURST**

When Buying a Preamp

Of importance are specifications, size, cost, and styling. "Listening" tests will not help here.

PROBABLY more thought has gone into the arrangement of the controls and the features to include in a preamplifier than for any other item in most manufacturers' lines. A good preamplifier has to compensate for differences in program material, differences in individual disc maker's recording characteristic, and differences in individual listening conditions or taste. It should also provide for different kinds of program input both from different types of pickups, so you can make your choice from the available types, and also for FM-AM and other sources. These program inputs will come in at different levels and different impedances.

Thus the preamp manufacturer is faced with the problem of how to cater to all these possibilities in the simplest possible manner. The solution offered by the individual manufacturer has invariably been the result of a considerable amount of thought and discussion. The pity of it, from the buyer's point of view, is that the dealer was not able to be present at all these conferences, and hence be conversant with the factors that made each manufacturer decide on his own particular arrangement. Had this been possible, he would be much better qualified to advise on the best preamp for your particular requirements.

In discussing preamplifiers here, we include not only the separate preamplifiers, but also that part of a composite amplifier where the preamplifier and power unit are combined on a single chassis. In this case the term "front end" might be more applicable. Last month's article covered the requirements of a power amplifier. The facts discussed apply equally well whether the power amplifier is a separate unit or is part of a composite unit. Now we will consider what is required at the input end.

Input Arrangements

If you have any kind of high-fidelity objective, do not take a preamplifier with a single phono input. The time is bound to come, sooner or later, when you will be dissatisfied with the quality of your system at some point and you will want to change various units in an endeavor to improve your system. The one thing you are certain to want to try is the relative merits of different kinds of pickups. To provide for this eventuality, your preamplifier should have at least two separate phono inputs; one identified as "high gain" (low level) and the other "low gain" (high level).

The high-gain input provides maximum gain in the amplifier and is used in conjunction with low-output pickups such as magnetic, ribbon, and moving coil types. Most amplifier manufacturers specify the input for use with both *G-E* and *Pickering* magnetic pickups. Actually all types can be used by making a slight change in the loading resistor in the preamplifier. Most pickups require a variation in the loading impedance and the manufacturer's suggestions should be followed for best frequency response. (Complete details on this will be covered in a forthcoming article.)

The low-gain input is for use with crystal and ceramic type pickups. These units have a much higher output level and therefore require a lower gain amplifier. The *Weathers* type can use this or the radio input.

You will also want to play radio through your high fidelity system, either AM, FM, or both. So you will also need a high-level (low gain) input to receive the output from your radio tuner. All-in-all you will require a minimum of three inputs: two phono and one radio. If you plan to use a tape recorder, either now or some time in the future, it would be advisable to plan on a fourth input stage. The preamplifier, or the front-end of a combined unit, may be regarded as the hub of your high-fidelity system.

Controls

From this we come to the question of how many knobs, with how many positions. Some preamplifiers provide control entirely by means of rotary knobs while others mix rotary knobs with lever switches, and yet others employ push-buttons for some functions.

For taking care of the record equalization characteristic, two methods are adopted. One employs separate means of adjusting the low-frequency end and the high-frequency end, while the other uses a single control for both functions. The use of two separate controls provides the greatest number of possible combinations. The question is: Will all of these combinations be used? A single knob (known as the equalization control) that takes care of both ends of the response by turning to the appropriate recording characteristic is the simplest for most people to use.

For the real high-fidelity fan who wants to have the maximum range of adjustment for a recording characteristic, separate push-buttons or knobs which can be arranged in any desired combination seem to give a more versatile unit; for example, two five-position switches give five times five, or twenty-five possibilities. The writer feels that this is a rather unnecessary refinement: the preamp usually carries a bass and treble control, separate from record equalization control, to handle variations in program material. The purpose of the equalizer setting is to provide a basic "flat" response for the recording characteristic selected. Equalization other than this can only add unnecessary complexity.

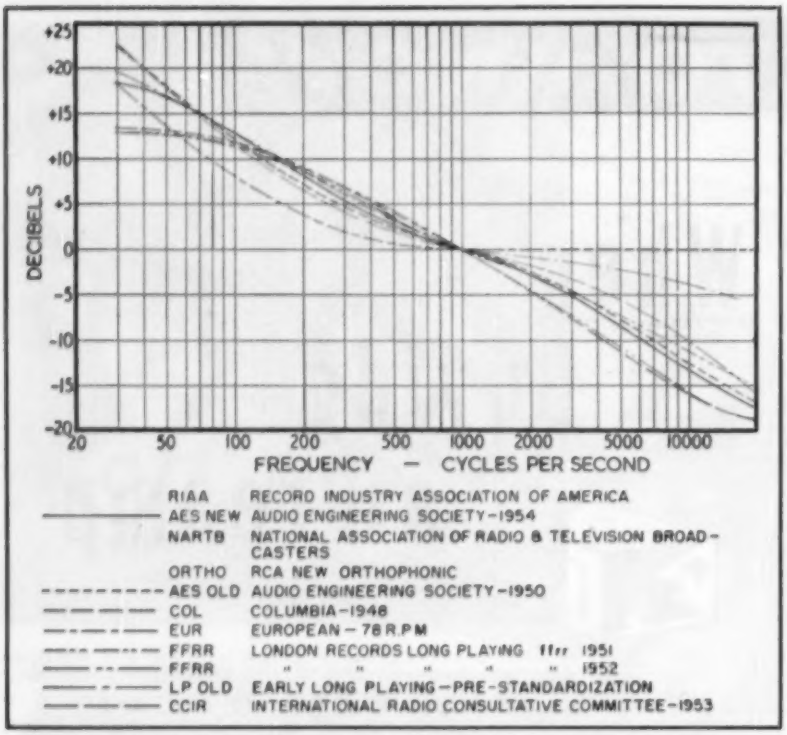
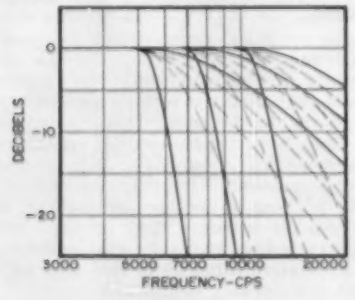


Fig. 1. Playback equalization characteristics for various recording standards. Dates given indicate the time the standard was established, where available.

Some manufacturers have reduced the number of positions on the equalization control since, for example, the AES and NARTB curves are so similar that the user can rarely hear the difference between them. An average curve is given for the two which is considered sufficient. Other related characteristics are covered by a single position. This results in a less expensive unit, because the number of precision components, necessary to produce accurately controlled equalization characteristics, is reduced.

It was pointed out in last month's article that a deviation in frequency response of 1 db or so cannot be detected by the human ear. Consequently the difference between the AES and NARTB equalization characteristic is difficult, if not impossible, to detect.

Fig. 2. Characteristics of one type of variable low-pass filter arrangement. Solid lines represent limiting responses at each frequency position. Dotted lines show kind of variation achieved by the continuously variable control. See discussion in text.



On the other hand, selection of the *correct* equalization characteristic assures the user that he has flat reproduction to start with before he adds other "quality" adjustments for program material or listening conditions.

To help the reader sort out the confusing range of equalization characteristics, Fig. 1 shows the variety encountered, and identifies the significance of sundry mysterious groups of letters!

On the question of equalizer switching, a point that is worth noting when listening to your equipment is whether or not there are any switching clicks when the equalization is changed. Many of the cheaper units do not provide click suppression, so adjustment of the equalization during a program results in unpleasant clicks. It is much nicer, and easier to tell what change is effected, if the clicks are suppressed so that the only change due to adjusting the switches is in the program quality.

Low-Pass Filter

The next control to consider, especially if you want your equipment to handle old records and make the best of them, or to receive radio programs of varying quality, is a variable low-pass filter arrangement. This provides good high-frequency response and noise rejection at the same time. The best equipment provides a selection of roll-off frequencies, with a continuously variable roll-off slope, or else provides a selection of roll-off slopes with a continuously variable roll-off frequency. Either arrangement will enable the position and roll-off to be adjusted to get the best possible performance from any given program material and background noise. Fig. 2 shows one way of achieving this.

However the addition of such a feature makes the preamp cost more; if you don't have occasion to play inferior quality program material through your system, you may consider such a refinement unnecessary, or perhaps be content with a variety that doesn't require two controls to adjust for best conditions.

Bass and Treble

Next we come to the bass and treble controls, which are designed to adjust the balance between low and high frequencies in order to improve original program material or compensate for the peculiarities of your listening room. Unlike the variable high-pass filter, these controls will not noticeably affect the relation between program material and background noise. They will affect the output at the bass and treble frequencies with relation to the middle.

There are two ways of making the response adjustable, as shown in Figs. 3 and 4. Which is better? That's a tough question to answer. To some extent it depends on the program material, so it might be advantageous to have a double control at each end—making four bass and treble control knobs in all!—so that we could vary the response both ways at once.

But let's not recommend any more knobs. The better choice is probably the type shown in Fig. 3, as the variation is positive and meets most requirements for this type of control.

Loudness

The next feature we'll discuss has been the cause of much argument. It is the loudness control. The argument involves just what we expect a loudness control to do.

A program reproduced at a level different from its original level does not sound real, because of the difference in the frequency response of the human ear at different levels. The term "scale distortion" was invented to cover the apparent change in quality which occurs when the reproduction level is changed from its original loudness.

From this the theory was developed that we need to compensate for the difference in the frequency response of the human ear at different levels, so that the music would appear to have the same frequency content or response at whatever level it is played. This *may* be what we require but this is open to question.

It is certain that it will not give an impression of realism. For example, a brass band at a certain distance has a certain loudness and program content. If the band moves farther away, or we go farther away from the band, the loudness and its apparent quality change. If we try to reproduce the

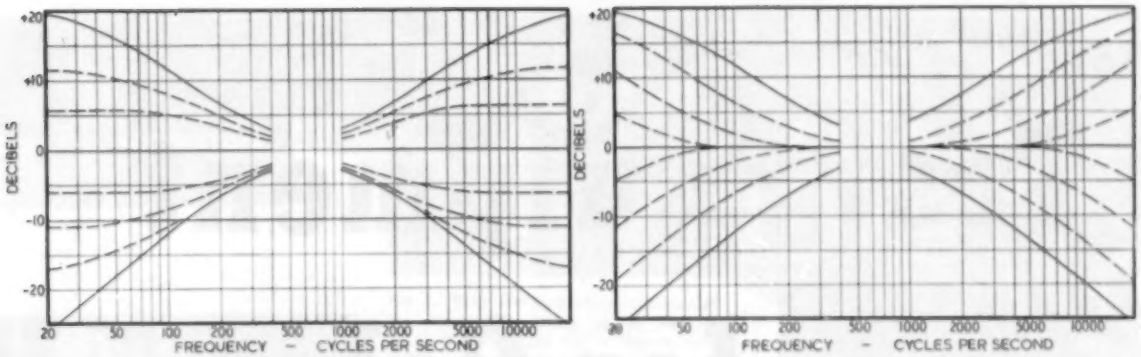


Fig. 3. One variety of bass and treble characteristic provided by some preamplifiers. The solid curves show limiting positions, while the dotted curves show typical response at intermediate settings.

Fig. 4. An alternative form of response variation provided by some bass and treble controls. This can have advantages over the form shown in Fig. 3, but for most program material the former serves best. A really deluxe control might provide a combination of both, requiring four knobs in all for bass and treble control.

band's music at a lower level than its original recorded level, but preserve the same apparent frequency components, it may give us something that is pleasing reproduction, but it will certainly not sound like a band either close to or far away. It will be as if the instruments are playing quite softly close to. And if you can imagine a trumpet playing full blast softly, then you may also consider that this kind of reproduction sounds real. But is realism in this sense our objective?

Turning to another aspect of the problem: we naturally like to hear all of the program material. If there are some bass instruments present, or a triangle contributing some very high-frequency components, we want to hear all of it. In point of fact, when listening to an orchestra from a distance or at low level, the low frequencies will actually be inaudible. But when we listen to reproduced program material, we know the low frequencies ought to be there and so we listen for them.

This means that we like to be able to increase the level at these frequencies so that we can hear all the instruments, even though they might not be audible in the original performance. The loudness control enables us to provide quick compensation for this so that as we change the reproduction level we don't lose the high and low frequencies, which happens if we get a long way from original sound.

Having decided this much—that we would like to have something in the nature of a loudness control—the question is: just exactly what do we want it to do?

An important feature to remember here is that *at no listening level is the response of the human ear flat.* Consequently, if we put in a correction for every different loudness contour of the human ear, we are putting in some compensation between the original program sound and our reproduced sound at every listening level. This means that even when the sound is reproduced at the *same* level as the original, it will not be reproduced proportionately because there has been some correction.

Obviously then, our loudness control should correct for the *difference* in loudness between the original recorded level and the level at which we wish to listen. The average recording level is somewhere around 70 phons.* Most probably you will want to listen at somewhere around 50 phons, if you intend to really listen to the program, or if you merely want pleasant background music, while you are giving attention to something else, such as conversation (I apologize to audiophiles for making this outrageous suggestion, but *some* people want it) a level of about 20 or 30 phons may be adequate.

So the loudness control should provide a differential compensation between the original 70 phon level of recording, and a 30 to 50 phon level for reproduction. If you want your reproduction as loud as the original, which is sometimes an objective so you can compare your reproducer system with original live program material, then you will also need a loud flat position, so that you can reproduce the material in your living room at 70 phons, and see whether you get the full experience of a live orchestra.

So if you want a loudness control, it should be separate from the volume control. This, of course, will raise the cost of the preamplifier. If cost is an important factor the loudness control could be omitted. Adjustment for deficiencies of the human ear can then be made by adjustment of the bass and treble tone controls.

Some preamplifiers provide a loudness control in addition to the volume control, so that a switch can select one of the loudness contours, while the volume control provides a fine loudness adjustment at any individual level. Other units provide an alternative volume or loudness control.

The difficulty of the latter method is that use of a loudness control to set the reproduced volume means that the differential action cannot be controlled apart from the volume. In this way it is not possible to compensate separately for differences in recorded level on the disc and for differences between the original loudness in the studio and in the reproduced program in the listening room.

Using separate volume and loudness controls, the volume control can be used to adjust the gain of the preamplifier to compensate for differences in modulation on individual discs, due to the fact that not all recordings are made at the same level in the wax, although they may have been recorded at a 70 phon level in the studio. The loudness control should be set in a position to correspond to the listening level actually desired. In this way good compensation can be achieved under all circumstances.

Background Noise

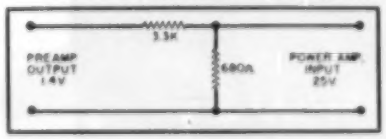
Last month's article on amplifiers discussed the question of background noise and showed the differences between possible forms of hum and noise. In equipment where the preamplifier and power amplifier are combined into a composite unit the discussion in that article applies.

For separate preamplifiers the same general principles about background noise relative to the specified figures can apply as well.

There is one thing, however, that the user can do to improve the background noise from his preamplifier, where he uses a separate preamplifier and power amplifier. The preamplifier will be listed as having a certain output within the rated distortion of the unit. Maybe

(*Continued on page* 163)

Fig. 5. Inserting this simple attenuator arrangement between a preamplifier and a power amplifier can improve the over-all discrimination against hum and background noise in the high-fidelity music system.



* A "phon" is a unit of loudness based on the average human ear where the ticking of an average-priced watch three feet away will register 30 phons.

Test Equipment for Color TV

The instruments described here are even more useful for color TV servicing than for black-and-white.

Fig. 1. Output of a color-bar generator as shown on the screen of a wide-band oscilloscope. Such an oscilloscope is essential for color TV work.

Fig. 2. Pattern obtained on a scope with poor high-frequency response to a 100 kc. square wave applied to the vertical input.

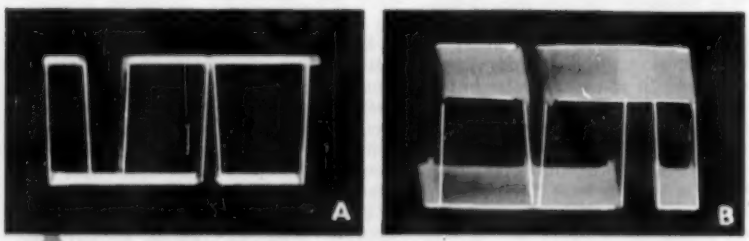


Fig. 3. When an oscilloscope has hum in its circuits, it will be reflected in the trace on the screen as shown here. (A) is a mild case of hum; (B) a bad one.

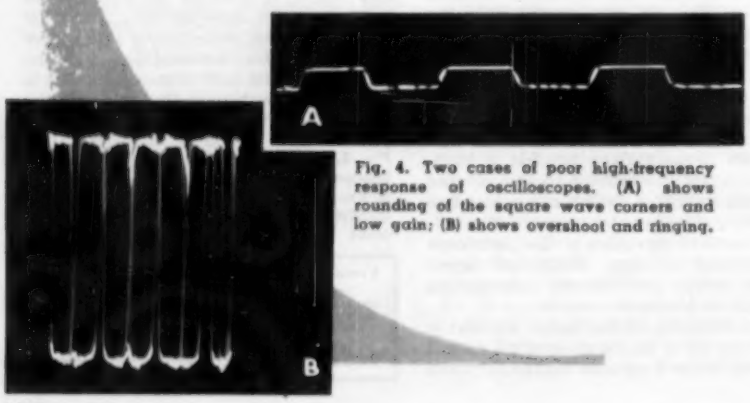


Fig. 4. Two cases of poor high-frequency response of oscilloscopes. (A) shows rounding of the square wave corners and low gain; (B) shows overshoot and ringing.

THE TV technician who works with color receivers can use most of his existing test equipment satisfactorily, but several new instruments will be found very helpful, if not essential. And, there are some shops that are interested in having all the tools of the trade.

The essential instruments are, of course, the color-bar generator, sweep and marker generators, the wide-band oscilloscope, the white-dot generator, and the v.t.v.m. Many shops regard a tube tester and a v.o.m. as essential, and also place considerable value upon a field-strength meter and oscilloscope calibrator. The purpose of this article, however, is to analyze the non-essential instruments which nevertheless ease the technician's burden by speeding up his work, and which contribute to a fully-equipped shop. Consider, for example, a square-wave generator; few technicians use such an instrument for circuit or instrument checking, although both applications are very valuable.

Using Square Waves

The wide-band scope must be in proper adjustment, of course, if the waveforms in the color TV receiver are to be reproduced without distortion. Fig. 1 shows a display of the output from a color-bar generator. Can the technician believe what he sees here, or is the scope introducing an unexpected distortion factor? There is one certain way to determine this point.

To determine the suitability of a scope for color TV applications, a square-wave test voltage is applied to the vertical input terminals of the scope. If the high-frequency response of the scope is poor (a very common situation), a 100 kc. square wave becomes rounded and distorted as shown in Fig. 2. The technician also observes

By
ROBERT G. MIDDLETON
Simpson Electric Company

Fig. 6. Poor low-frequency response of the vertical amplifier of an oscilloscope results in the traces shown here when a square wave is used, see text.

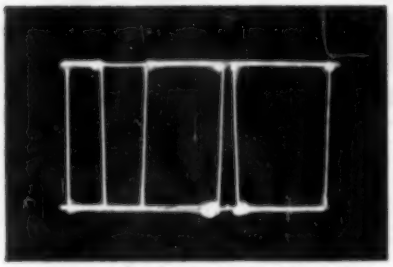


Fig. 5. Uncertain sync lock, ringing, and poor retrace blanking are shown here.

Fig. 7. Satisfactory response of an oscilloscope to a 60 cycle square wave is shown here. Note the sharp, clean focus.

here that the scope does not have retrace blanking action, and that the retrace is as prominent as the forward trace, which confuses the pattern.

Fig. 3 shows some other common situations encountered when this test is made. The low-frequency response of an oscilloscope which has some 60-cycle hum present in its circuits, or in the output from the square-wave generator, is shown in Fig. 3A. In Fig. 3B, is seen the low-frequency response of a scope when there is a *large* amount of 60-cycle hum present.

Sometimes the scope has low gain as well as poor high-frequency response. In such a case, the pattern is short and has rounded corners, as shown in Fig. 4A. Other scopes may exhibit overshoot and ringing at high square-wave frequencies, as shown in Fig. 4B. Note that retrace blanking is satisfactory in Fig. 4A, but is unsatisfactory in Fig. 4B.

A scope which has good horizontal gain at low frequencies may have poor horizontal gain at high frequencies. This situation appears in Fig. 4B, which was photographed with the horizontal gain control advanced to maximum. The pattern does not fill the screen horizontally because the frequency response of the horizontal amplifier is poor, and when the horizontal sweep is speeded up to display a 100 kc. square wave, the gain of the horizontal amplifier is only a fraction of its gain at lower frequencies, and adequate horizontal width cannot be obtained.

If the square-wave pattern reproduced by an oscilloscope appears blurry and jittery, as shown in Fig. 5, the technician should question the suitability of the scope for color TV applications. The pattern shown in Fig. 5 also exhibits evidence of overshoot and ringing at the leading and trailing edges, and poor retrace blanking. These are the points to look for when checking out a scope for color TV work.

When the low-frequency response of a scope is poor, the reproduced square wave has tilt, as shown in Fig. 6A. A more pronounced case of poor low-frequency response to a 60-cycle square voltage is seen in Fig. 6B, in which curvature is apparent in the top of the reproduced square wave, as well as tilt. Such scopes distort visual-response curves in sweep-alignment procedures.

By way of comparison, Fig. 7 shows satisfactory reproduction of a 60-cycle square wave, without tilt or curvature. The trace is also sharply focused and clean, which is an asset in color TV waveform inspection.

Another valuable, although perhaps not essential, instrument for the color TV service bench is the capacitance bridge. A capacitance bridge is similar to a resistance bridge, except that it measures values of capacitance instead of values of resistance. The capacitance bridge, like the resistance bridge, makes possible the accurate measurement of capacitance.

Many technicians, of course, assert that substitution tests can be made when a capacitance value is in doubt; however, few shops stock *all* values of capacitors at *all* times. Experience proves that a job can often be speeded up with a capacitance bridge, to check a capacitor in a chassis when an exact replacement is not immediately available. And the experienced technician has learned, too, that a capacitor which has a suitable value of capacitance may nevertheless have leakage resistance present which does not show up on an ohmmeter. For this reason, the capacitance bridge should be supplemented with a leakage tester which operates at the rated working voltage of the capacitor. In other words, leakage resistance sometimes does not show up at 1.5 volts or 3 volts (potential used in the ohmmeter), but will appear when 100, 200, or 500 volts are applied across the capacitor.

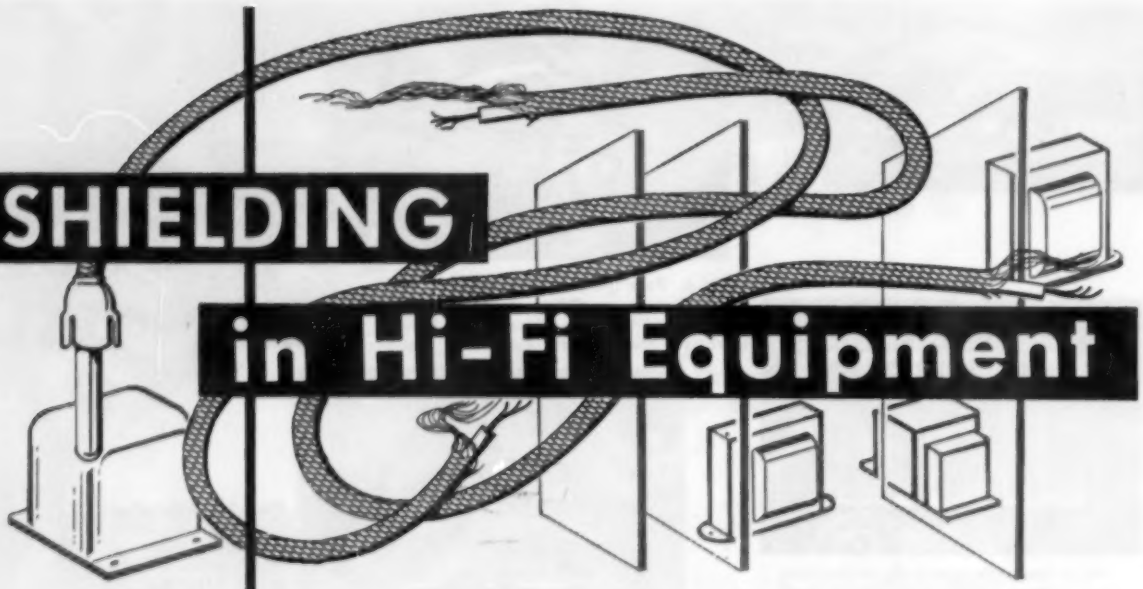
Instruments are now available which will show whether a capacitor is shorted or open, right in the receiver circuit, without disconnecting the capacitor. These in-circuit testers are offshoots of the more conventional capacitor leakage testers, and often serve to rapidly locate a faulty capacitor in a color TV chassis. The completely equipped shop, accordingly, provides this specialized tester for the convenience of the bench man.

Finally, the completely-equipped color TV shop makes use of the invaluable "*Q*" meter. These instruments are no longer prohibitive in price, being available even in kit form. The "*Q*" meter finds extremely valuable use in color TV work, and, when its operation is understood, the quality of tuned inductors, transformers, and capacitors is quickly and accurately measured.

What is meant by the *quality* of an inductor or a capacitor? It is a characteristic called "*Q*," and is a measure of the unit's reactance divided by its high-frequency resistance; *i.e.*, "*Q*" is the fraction X/R. When R is small, the "*Q*" is high—and note carefully, R in this case is *not* the value of R indicated on a simple ohmmeter, it is the *high-frequency resistance* of the coil, which is quite another matter. The only practical way to measure high-frequency resistance in the shop is to use a "*Q*" meter.

Of course, it is not expected that every color TV shop will have a "*Q*" meter or a capacitor checker. But those shops desiring to do high quality work in a minimum of time should certainly investigate the advantages of these instruments. —30—

SHIELDING in Hi-Fi Equipment



Many of the facts covered herein will be helpful when shielding your equipment for best performance.

By **W. PHILBROOK**

AT FIRST SIGHT, shielding seems to be a pretty simple little topic, but often it does not behave quite the way it is expected to, and even some of the more expert engineers get into difficulties trying to find out why. So there is no need to apologize for introducing a further article on this deceptively simple subject.

One still meets such questions as: do you ground both ends of a shielded lead? Does a magnetic shield need grounding? Should the material for a magnetic shield have high or low resistance? How important is the permeability of the material? These are only some of the questions that one encounters. There are other aspects that are not clearly understood—in particular, why it is that a high grade transformer, advertised as having a high degree of shielding which checks under test conditions, seems to have inferior shielding under practical circuit conditions? How is this discrepancy explained, and can we do something about it?

Let's start by making sure that we have a clear understanding of what constitutes each of the three basic varieties of shielding.

Magnetic Shield

A magnetic shield is made of magnetic material. The essential property of the material is that it should have a very low hysteresis loss. The purpose of the shield is to capture the magnetic field and lead it around the object to be screened, which is usually a transformer, without affecting it magnetically.

High permeability is a good thing, but more important is the fact that the hysteresis should be low. The permeability ensures that the path for the magnetic field is effectively short-circuited around the object inside the shield. Where the magnetic field is steady, due to pure d.c., the higher the permeability the smaller will be the field inside the shield.

But d.c. fields are not usually the cause of worry. It is more important to make sure that an a.c. magnetic field, such as one radiating from a power transformer or choke, does not get into an input or interstage transformer. This means that a fluctuating field must not pass through the shield. When the field fluctuates, it is important that the magnetic condition of the shield should closely follow the fluctuations of the magnetic fields.

Hysteresis means that the magnetic condition in the shield is delayed behind the magnetizing force causing it, and this means that there will be a difference between the magnetizing force and the short-circuiting effect produced by the magnetic shield. This difference will reappear as a leakage field inside the shield, so it doesn't matter how high the permeability of the material is, if it shows appreciable hysteresis, it will become a poor shield. So a primary requirement is a magnetic material with extremely low hysteresis.

While on the subject of magnetic field we can answer the question as to whether the material should have a high or low resistance. Since eddy-current losses are similar in nature to hysteresis losses in producing a delay in the magnetic field set up, they will have the same effect of deteriorating the quality of the shield. This means that a magnetic shield should be of a high-resistance, low-hysteresis-loss alloy.

The thickness of the shield will have an optimum value too, for any given frequency. Making the shield thicker will decrease the flux density in the material of the shield and so reduce hysteresis loss. But, at the same time, it will increase the path section available for eddy currents, and so increase the component of eddy-current loss in the shield. At some thickness, for any specified frequency, there will be an optimum which will provide a maximum reduction in field due to the magnetic shield.

Magnetic shields for input and interstage transformers are usually made of *Mumetal* or a similar material. An important feature for their satisfactory operation is that any lids or joints in the shield should be a good close fit so as to provide a good *magnetic* contact. Fig. 1A shows how a magnetic field is led around the shielded space by a magnetic shield, while Fig. 1B shows the effect of a poor joint at some point in the shield: the reluctance at the joint causes some of the field carried around to be re-radiated on the inside of the shield.

To answer another of the questions asked at the beginning of this article: does a magnetic shield need grounding? The answer to this question is: no. A ground connected to a magnetic shield has no effect upon its magnetic shielding properties. However it often happens that a subsidiary effect of a magnetic field is to provide static shielding, which will be discussed later. For this purpose grounding is absolutely necessary and hence it may be

advantageous to ground a magnetic shield so that it provides static shielding as a subsidiary effect.

It is important in a magnetic shield that there should be no holes or that any necessary holes in the shield should be as small as possible.

Also, if the *Mumetal* has to be drilled, or worked on in any manner, after its pressing, it should be reannealed after work, so as to operate at the lowest possible hysteresis loss.

Mumetal and similar materials are not suitable against very strong magnetic fields, because they saturate at a fairly low flux density. Therefore shields of these materials are only suitable in magnetic fields where the saturation density of the metal is not approached.

Magnetic shields are more effective against the lower frequencies, their greatest effectiveness being against a d.c. field, which is virtually zero frequency.

Electromagnetic Shields

Electromagnetic shielding keeps a magnetic field out by the principle of electromagnetic induction. It depends on the variation in magnetic field, rather than on eliminating the magnetic field itself. Consequently it is inherently more effective at higher frequencies than at low frequencies and is completely ineffective against d.c. fields.

Fig. 2 illustrates the principle. At Fig. 2A the original interfering field is shown with dotted arrows, the currents induced by the electromagnetic field are shown by the solid arrows, while the fields due to these induced currents, opposing the original field inside and aiding it outside, are shown by hollow arrows.

The resulting field around such an electromagnetic shield is shown in Fig. 2B. The shield is shown open-ended to demonstrate the manner in which the shield works. In practice, electromagnetic shields may be complete cylinders, with the ends filled in, in which case they will be equally effective in eliminating fields in any direction. The circular band shown will only be effective in eliminating fields along the axis of the cylinder.

For this kind of shield it is important that any lids or joints should make good *electrical* contact. There must be no gaps of any kind in the shield and it should be constructed of a low resistance material such as copper or aluminum. Sheet tinned iron does not make an effective electromagnetic shield because the iron will not make a good magnetic shield and its effect on the current in the tin will interfere with its operation as an electromagnetic shield.

Electrostatic Shielding

This kind of shield does not concern itself with magnetic fields, but with electric fields. It is intended to keep electric fields out or in as the case may be.

A good ground is essential to the operation of an electrostatic shield, although this was not vitally necessary to either of the other types. The purpose of an electrostatic shield is to interpose a grounded shield between two interacting potentials that might radiate from one to another. Fig. 3 shows the way in which an electrostatic shield intercepts an electric field.

In an electrostatic shield, provided the material is basically a conducting material and not an insulator, it is not important for it to have particularly low resistance. Tinned sheet iron will serve as well as any other material for this purpose, provided it is not also required to serve as a magnetic or electromagnetic shield.

Applications

Having differentiated between the various kinds of shield, we can now see how they may be applied. The first thing to consider is the kind of field against which shielding is required.

If it is basically a magnetic field, due to a power transformer, a choke, or a motor, then a magnetic or electromagnetic shield, or a combination of both, will be necessary to eliminate hum pickup effects.

If, however, we are concerned with a high impedance circuit, in which static fields due to power line voltages around the place can cause trouble, then electrostatic shielding is required.

Where a transformer coil is involved, such as an input or an interstage transformer, magnetic or electromagnetic shielding is invariably required. If one of the windings is high impedance, then electrostatic shielding may also be necessary to protect the high impedance winding against static pickup.

In circuit wiring, the kind of shielding needed will depend upon the impedance of the circuit.

Low-impedance circuits, where an interacting magnetic field may induce relatively large currents, require some kind of shielding to eliminate this effect and, if a shielded lead is used, its primary purpose is to eliminate the induction of current in the circuit, rather than to eliminate the effect of static potentials.

In high-impedance circuits it is static potentials, alternating or direct, that have to be guarded against, and this requires electrostatic shielding.

To return now to the questions asked at the beginning of the article. *Do you ground both ends of a shielded lead?* If the shielded lead is intended solely for protection against electrostatic field, it doesn't matter how many times it is grounded. But it is also important that the shielded lead should not produce induction in the lead it is shielding. If there is any difference of potential between the points at which it is grounded, there will be a current flowing in the shield due to this difference of potential and this current will produce an induced current in the lead it is shielding. For this reason it is dangerous to ground both ends of a shielded lead.

There may be a difference of potential between the ground points to which the two ends are connected, and if this should occur, the shield will be effective against electric fields, but at the same time, it will be responsible for injecting, through electromagnetic induction, another source of interference which may not be present before both ends are grounded.

Distorted Magnetic Fields

Now we come to the sixty-four dollar question: the one about why measurements on effective shielding

(*Continued on page* 108)

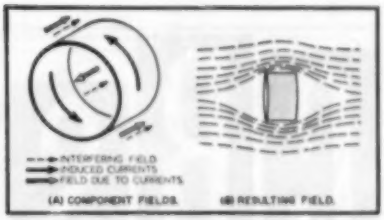


Fig. 2. How an electromagnetic shield operates with a fluctuating magnetic field. (A) The relative directions of the interfering field, the induced current, and the induced field, at one instant during changing sequence. (B) Resulting field contours.

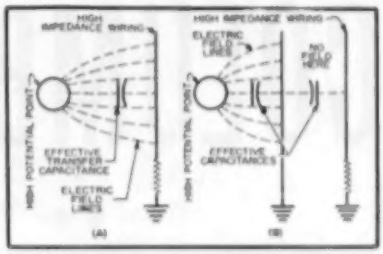


Fig. 3. How an electrostatic shield intercepts an electric field. (A) Electric pickup in the absence of a shield. (B) How the shield intercepts the electric field.

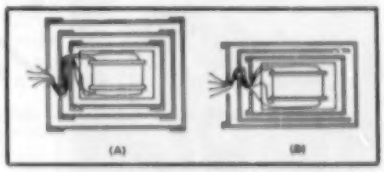


Fig. 4. Construction of multiple shielding for a transformer. (A) Ideal construction where each cylinder is complete. (B) Commercial compromise which has similar properties to (A) for a linear field but not for an asymmetric field. Refer to article.

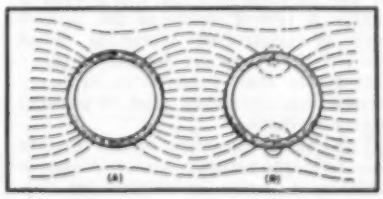
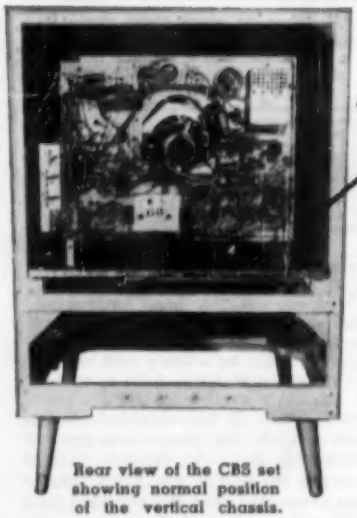


Fig. 1. How a magetic shield operates with a steady magnetic field. (A) Good shielding. (B) Effect of poor magnetic contact causing leakage of the field. See text.

CBS-COLUMBIA TEST POINTS

Fig. 1. Dan Newman, Director of Service of CBS-Columbia, is shown changing a tube in the new vertical tilt-back TV chassis.



Rear view of the CBS set showing normal position of the vertical chassis.

By **JOSEPH J. ROCHE**
CBS-Columbia Product Service Department

A bright new idea in chassis mounting with liberal number of test points. It makes servicing easier.

THE new *CBS-Columbia* 1610 and 1611 TV chassis have a number of unique features. Possibly the most interesting to the technician is the mounting and construction of the chassis.

The chassis is mounted vertically with the tubes facing the front of the set. All small components, adjustments, and tube sockets are exposed when the receiver's back panel is removed. To replace tubes two thumb screws are removed and the chassis tilts out of the cabinet at a 45 degree angle as shown in Fig. 1. This ingenious feature makes it possible to align, troubleshoot, and repair the chassis without removing it from the cabinet—a real timesaver.

All leads remain connected when the chassis is in the tilt-out position, permitting operating tests and measurements to be made without restoring the chassis to the upright position. Removal of the chassis is required only for replacement of the tuner or picture tube.

Controlled warm-up characteristic tubes are used in a series-string heater circuit. These tubes have now been in use in *CBS* sets for more than a year. A recent study of the failure rate of controlled warm-up tubes showed that they are somewhat more dependable than tubes with ordinary heater characteristics used in parallel heater circuits.

The chassis mounting makes it quite easy to locate an open heater. A simple neon light tester is helpful for this purpose. The tester is bridged across the heater socket pins of each tube. The tester will glow when connected across the open heater. If a neon tester is not available, an a.c. voltmeter with a 150 volt, or higher, range may be used. Connect the ground lead of the meter to the chassis. Starting with the hot lead of the meter on pin 7 of V_8, (see Fig. 2), proceed to check the voltages on the heater pins of each tube in the order shown in Fig. 2. The tube with the open heater will read 115 volts on one heater pin and zero on the other. If no reading is obtained on pin 7 of V_8, check for an open heater dropping resistor.

The 1611 chassis employs a 12-position cascode turret tuner. The tuner may be adapted for u.h.f. operation by substituting a u.h.f. strip for an unused v.h.f. strip in the tuner drum. The u.h.f.-v.h.f. version of this chassis, designated the 1610, employs a 13-position cascode turret tuner and a single-conversion u.h.f. tuner. In the 13th position, the tuner oscillator is disabled and the tuner r.f. amplifier and mixer function as 40-mc. i.f. amplifiers. In all other respects the 1610 and 1611 chassis are identical.

Both the 12- and 13-position tuners have a test point located near the converter tube. This test point may be used to determine whether or not the local oscillator is functioning. A v.t.v.m reading of approximately —1.5 volts will be obtained when the oscillator is operating properly. In the 13-position tuner this check should not be made

with the tuner in the 13th, or u.h.f. position, since the oscillator is automatically disabled under this condition.

The construction of this receiver eliminates the need for the usual type of test point. The wiring side of the chassis is exposed with the cabinet's back cover removed, and there is no need to bring out key circuit points to make them available when the chassis is in normal operating position.

The technician will, however, find it helpful to follow the test point method of diagnosing a trouble. For this reason, a number of key points which may be used for this purpose are shown in Fig. 2. With the exception of the tuner test point these are normal tube socket connections and terminal board tie points.

The use of the test points is covered in Table 1. The voltages and waveforms shown in the table are for a normally operating receiver tuned to a station. Where the condition of the set makes it impossible to tune in a station in the normal way, the controls should be set as close as possible to their correct positions. If alignment is required, it can be accomplished with the chassis in the upright position by using a double-ended hex-type alignment tool. The short end of the tool is used to engage the rear (normally bottom) slug of an i.f. can. The front slug is adjusted with the long end of the tool which passes through a hole in the rear slug.

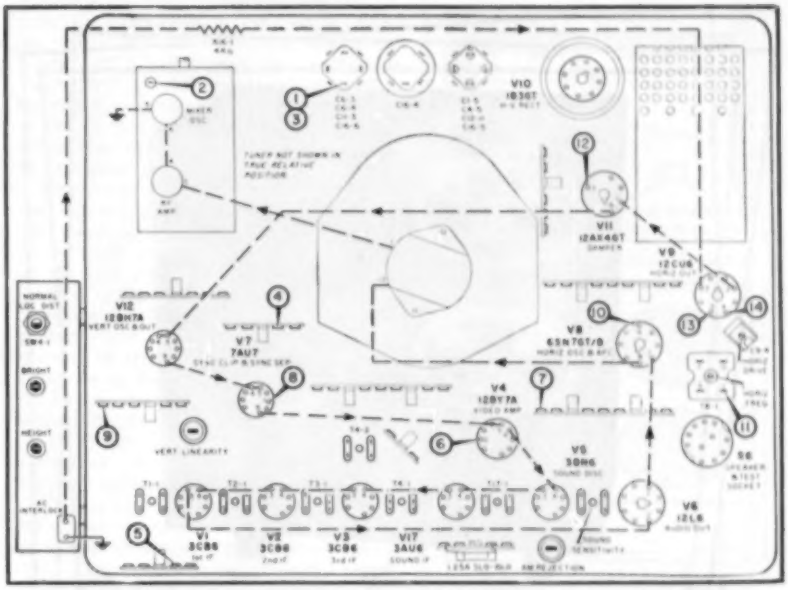
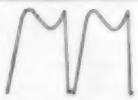


Fig. 2. Tube location diagram of the new CBS-Columbia TV chassis showing the test points mentioned in Table 1. The dotted line indicates the order in which the tube heaters are tested if the tubes do not light up (they are in series).

While the test points shown in Fig. 2 provide a good approach to trouble-shooting this chassis, all of the chassis wiring is readily accessible and the reader is free to use those techniques he is familiar with and has found most effective in the past. —30—

Table 1. The method for checking the CBS-Columbia TV sets via the use of test points, v.t.v.m., and oscilloscope.

SYMPTOM	TEST POINT	NORMAL READING OR WAVEFORM	TEST PROCEDURE
No raster, no sound, tubes light	1 "B+" line	280v.	If reading is abnormal check for a blown fuse or "B+" short. Check whether speaker plug is out of socket.
Snowy pix, weak sound, raster OK or No sound or video, raster OK	2 converter test point	—1.5v.	Voltage varies with channel used—check other channels. If OK, replace oscillator strip of affected channel—if not, replace converter tube.
	3 & 4 tuner "B+"	280v. & 140v.	Check high & low "B+" to tuner. If low reading, remove tuner leads. If voltage OK, trouble in tuner. If not, check for "B+" short in chassis.
	5 a.g.c. line	—2.5 to —4.5v.	Check setting of "Local-Distant" switch for signal conditions. Check a.g.c. components and i.f. tubes.
Weak or no video; raster and sound OK	6 input, video amp 7 output, video amp	4 to 5v. p-p 120v. p-p	Comparison of video signal before and after video amplifier should show gain of about 25 at full contrast. If reading abnormal, check video components.
Loss of vert. & horiz. sync	8 input, sync clipper	100v. p-p	If waveform OK, check of voltage and resistance in sync stages should localize trouble. If not, check coupling components from video amp.
Loss of vert. sync, Horiz. sync OK	9 output, integrator	18v. p-p	If waveform OK, trouble in vert. osc. or output stages. If not, trouble in sync or integrator circuit.
Horiz. hold unstable, Vert. hold OK	10 grid, horiz. osc.	—50 to —60v.	Voltage varies with horiz. hold. If reading abnormal, check a.f.c. and osc. stages. If OK, check horiz. alignment.
	11 horiz. freq. coil	 130v. p-p	Connect scope to terminal "C" through 10 μμfd. capacitor. Connect jumper from "C" to "D." Adjust rear slug to lock picture through most of horiz. hold range—remove jumper and adjust front slug for waveform.
No high voltage or insufficient width	12 cathode, damper	525v.	If OK, check the 1B3GT. If not, check test points 13 and 14.
	13 grid, horiz. out.	—27v.	If abnormal, check drive control setting and horiz. oscillator.
	14 screen, horiz. out.	136v.	If abnormal, check for open screen resistor. Should read 8200 ohms.

A Novel Push-Pull Speaker System

By GLEN SOUTHWORTH

The front panel and grille cloth have been removed to show internal construction and speaker mounting of the push-pull enclosure.

The push-pull arrangement has several advantages over the conventional method of speaker mounting.

ALTHOUGH a great deal of effort has been expended in the development of multiple speaker systems, there still seems to be several deficiencies that are disturbing to some listeners. The most serious problem seems to be in matching the sound *quality* of a woofer, a mid-range speaker, and a tweeter in such a manner that they blend together naturally and avoid effects such as seemingly having the violins playing in one room, the cellos in another, and the basses in yet a third. This causes a lack of continuity in musical reproduction, and although it may give the impression of added clarity, it may also tend to make a large symphony orchestra sound somewhat like a chamber group.

Specifically, here are some of the problems that may be encountered in putting together a good multiple speaker system using crossover networks to divide the range between low, medium, and high frequencies. First, to match the sound of the three speakers attention must be paid to the distortion characteristics of each unit, to the transient response, to the type of loading used, the power handling capability, the acoustic path lengths between the speakers and the listener, proper phasing of the speakers and crossover networks, and, of course, satisfactory frequency response for each of the three speakers. Unfortunately, the factors of distortion, transients, and load matching seem to be frequently ignored in commercial speaker systems, as is the problem of matching acoustic path lengths, and such systems might be characterized more as musical instruments than reproducers.

A second series of problems stems from the fact that the speaker system must be supplied with electrical energy from a power amplifier, and the interactions produced may lead to additional distortions. The multiple speaker system, together with its crossover networks, represents a complex reactive load that may cause continuous or damped oscillations when connected to an amplifier using feedback over the output stage. This seems especially true when using highly efficient speakers, due to the fact that the back e.m.f. of the speakers represents a positive feedback component of varying phase and amplitude. However, these problems may be reduced by using an amplifier with only a modest amount of feedback, or by placing a 6 decibel resistive pad between the speaker and the amplifier output.

In order to minimize most of the previously mentioned problems, a number of experimenters have adopted the idea of using clusters of small speakers with light enough cones to adequately reproduce the middle and high ranges, and with sufficient total surface area to move enough air to satisfactorily generate bass tones. In a system of this kind the major problem is simply to select the right speaker for the performance desired. This, of course, is not necessarily easy, as many small speakers will not perform well below 200 cycles or above 3000 or 4000 cps. A good compromise seems to be found in the 6" x 9" oval speakers, such as the *Oxford* 69EVS. These speakers have a primary resonance of approximately 120 cycles, but are capable of reproducing, with low distortion, at least an octave below this point. At the high frequencies, performance is even more surprising due to the oval shape of the cone, which gives sine wave and transient performance approximating that of a 2" speaker, being virtually flat to 9000 cycles.

The accompanying photographs show four 6" x 9" oval speakers mounted in a three and one-half cubic foot enclosure. Voice coils are connected in series to provide a nominal impedance of 13 ohms, and properly phased for maximum efficiency at low frequencies. The first enclosure uses all four speakers mounted in the same manner, and is capable of excellent performance, the radiating area of the four cones being nearly equivalent to that of a single 15" speaker.

The second enclosure is similar to the first, except that two of the speakers are faced into the cabinet and the polarity of their voice coil connections is reversed in order that all of the cones travel in the same direction under an applied signal. This "push-pull" arrangement of loudspeakers appears to have at least two distinct advantages, the first of these being the reduction of even-harmonic distortion at low frequencies. This is especially important in view of the fact that the conventional cone speaker is an aerodynamic shape that simply moves air more efficiently when it is traveling

outward than when it travels inward, and the air mass tends to slip past the apex of the cone. This seems especially true at frequencies below the primary resonance of the cone where the speaker is no longer mass controlled and diaphragm excursions become relatively large. The result is a lack of symmetry in the acoustic output of a single-cone speaker which may be greatly reduced by using an even number of speakers in "push-pull."

A second advantage of push-pull operation stems from the fact that while the speakers are acoustically in-phase, they are electrically out-of-phase and, as a result, the back e.m.f.'s tend to buck each other and cancel out, thus presenting a more nearly resistive load to the amplifier. However, if sufficient power is available from the amplifier, it may be desirable to place a 15-ohm, wirewound, variable resistor in series with the speaker system. The resistor should preferably be located close to the output of the amplifier in order that effects of cable capacitance on the amplifier may be reduced.

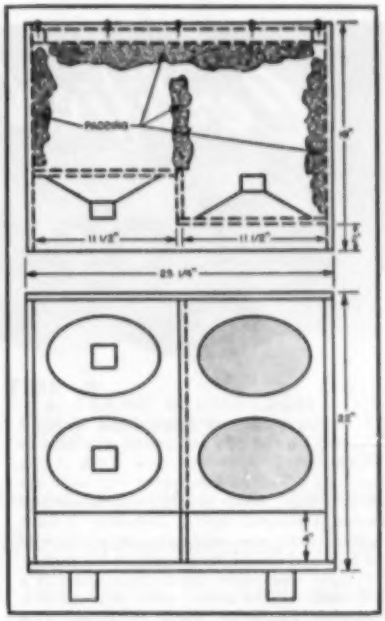
There are a number of mixed blessings in the use of multiple speaker systems of this nature. Chief of these is the fact that small cones usually mean high resonant frequencies compared to large, heavy, single unit woofers. Although this means a peak in the response curve at about 100 to 140 cycles, it also means superior transient response, due to the low mass of the individual small cones. This is especially true in the octave just below resonance, where the speakers are no longer mass controlled. As a consequence, the lower voices of the orchestra, such as the cellos, contrabassi, tubas, bass saxophones, etc., seem to reproduce with a fuller, more sonorous sound due to the fact that their transient components are more adequately radiated.

Another advantage in using small speakers is their sensitivity to weak electrical signals. For example, the push-pull speaker system using *Oxford* 69EVS's will produce an audible signal with an electrical input of as low as 1/100 millionth of a watt, and will reproduce natural and pleasing music at peak inputs of one milliwatt or less. This is a very important factor, even when listening at room shaking volume levels, as the weaker signals must be properly radiated or many of the less powerful instruments in the orchestra will be lost or masked out. This frequently leads to poor balance, particularly in the bass region due to the weakness and transient nature of most bass instruments. Even when excessive amounts of electrical equalization are used, in order to make reproduction more tolerable, lack of sensitivity may cause a large symphony orchestra to sound like a chamber group recorded in a small room.

As mentioned earlier, phasing is a problem with any multiple speaker system due to the differing acoustic path lengths of the speakers. In the push-pull speaker system interference in the mid- and high-frequency range may be minimized in two ways: first by using acoustic low-pass filters to block off high-frequency radiation from part of the speakers; secondly, by staggering the speakers so that the peaks in one set of speakers tend to fill in the valleys of the response curve of the other set.

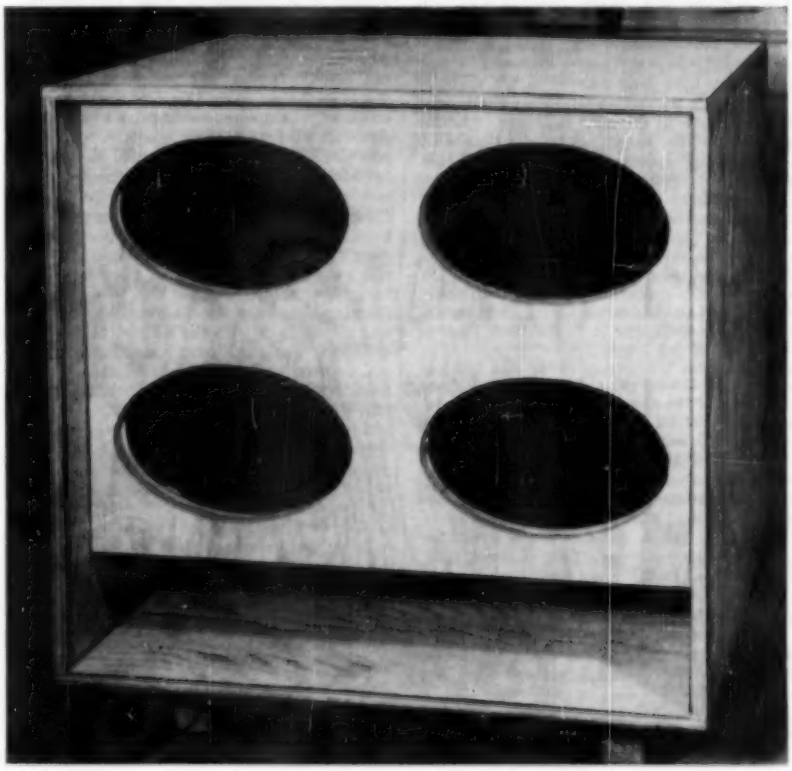
The complete push-pull speaker system in the three and one-half cubic foot enclosure is essentially flat from 80 to 9000 cycles, being down 10 db at 60 and 10,000 cps. It will reproduce a dynamic range of 90 decibels comparable to the best available amplifiers, and exhibits superior reproduction of transient signals. Sine wave response is clean over the entire useful range of the speaker system. The design is simple and economical and presents few of the problems of conventional two-, three-, or four-way speaker systems.

The actual performance, listening-wise, has been carefully observed for over two years in conjunction with a wide variety of equipment, input sources, and acoustic environments, including service in high-quality sound re-enforcement. In all cases it has faithfully reflected the quality of the signal applied to the voice coil terminals. Especially recommended is the use of two of these speaker systems, as this allows some compensation for the effects of room reflections and creates a sound "image" in the space between the two enclosures. The resulting spaciousness of sound creates a much greater illusion of reality, and transmits the acoustics of the original pickup into your living room, even with old shellac recordings. —30—



Dimensions of 3½ cubic foot enclosure for push-pull speaker system. All panels should be of ¾" plywood. All joints should be glued and nailed, except back which is screwed on. Sides are lined with acoustically absorbent material as shown above.

Four 6" x 9" oval speakers are wired in series and mounted in conventional manner. The shape and size of the enclosure is the same as shown in the diagram above.



By **BERT WHYTE**

AS regular readers of this column know, I report on the new equipment available to the enthusiast, after the New York Audio Fair. As per usual, this report will be in the January issue, which should reach subscribers around Christmas-time. However, I have received some new equipment in advance of the Fair and one of the items is so interesting, I thought you might like to hear about it a little earlier. The item I refer to is the new *Pickering* "Fluxvalve" phono cartridge. This pickup represents a distinct departure from previous *Pickering* production. First difference readily apparent is that all moving elements are hermetically sealed in plastic. Of turnover design, on each side of the cartridge is a small, round, silvery contact and directly to the rear of this contact is a narrow slot. Styli are mounted near the "crossed" end of a plastic "T," which is inserted in the slot. With the "T" snugly in its slot, another silver contact on the "T," directly above the stylus armature, lines up with the contact in the cartridge body. Thus the magnetic flux is "valved" between stylus and moving element. The cartridge is normally supplied with a 1 mil diamond on one side and a .0027 sapphire on the other. Obviously, styli are interchangeable which will please *Pickering* enthusiasts who have long wanted such a feature.

Now there are certain advantages and some disadvantages to this new cartridge. On the plus side of the ledger is the fact that with the "valving" system, the compliance of the stylus is very great and makes for easy tracking of even the most difficult transients. The frequency response is ultra-wide, being plus or minus 2 db from 10 to almost 30,000 cycles! Distortion is stated to be below 1% for both harmonic and intermodulation. On the basis of a quick run through with some test records and in listening tests, there would seem to be no reason to doubt these figures. Normal tracking pressure is between 3 and 4 grams, which cuts record wear and reduces needle talk. On the debit side are these factors . . . because the moving elements are encased in plastic instead of the usual Mumetal, hum pickup is a problem. In fact, so much of a problem that the use of this new cartridge is not recommended with changers or the less expensive turntables. As far as arms are concerned, the unit worked fairly well in a number of high quality arms generally available, but maximum performance was obtained with the *Pickering* 190B. Since the "Fluxvalve" is so responsive in the really low frequencies, rumble is also a matter of some concern.

Despite these problems, one of the reasons I was so interested in this unit and anxious to tell you about it, is that it is the first pickup to successfully utilize a ***half-mil*** *(.0005) stylus!* Let me tell you about these half-mil styli, which I consider a major advance in the reproduction of disc recordings. These minute styli are half the diameter of the standard .001 LP, but are only *one quarter* the mass (weight). Few people realize the tremendous forces at work in the playback of an LP. As the stylus approaches the inner diameters of the record, on sharp transients and heavily modulated passages (which unfortunately are common at the finale of most works, since composers like to end their works with a bang) the stylus tip velocity can reach incredible speeds. Forces as high as 2000 gravities are fairly common! Naturally, these fantastic speeds make tracking extremely difficult and various distortions occur. With the half-mil stylus having only one quarter the mass, these inner groove forces are reduced by one-half, or to about 1000 gravities.

The same principle is active throughout the disc and this is most apparent, ear-wise. All manner of transients, whether from percussion of various kinds, or piano or brass, woodwinds, etc. are heard with a marked increase in clarity and articulation. Most sensational aspect of the half-mil stylus, which will have especial appeal to hi-fi bugs is this: it is possible to make old, grooveworn records sound almost brand new! You see the groove destruction wrought by the standard 1 mil stylus, is confined largely to the *top* portion of the groove. Unless the stylus you were using was a veritable gouge or chisel, which extended the damage further *down* into the groove, the smooth round ball point of the half-sized stylus will ride down further in the groove, where normally it is relatively undamaged.

My wife and I have a certain favorite recording which we have played many times over a period of four years. Although top-notch equipment was used for all of this playback, the record nonetheless was audibly showing signs of wear. When this recording was played back with the half-mil stylus, the difference was startling. Record noise was greatly reduced, once again the record sounded like a clean new disc, with the added plus that the improved transient response added a realism which heretofore was not apparent. Truly, this half-mil stylus is a far-reaching development. Summing up this report on the new *Pickering* "Fluxvalve" we can say this: if you use it correctly with top quality turntables and its own arm, this is a magnificent sounding pickup. By following the recommended grounding procedures (which depart slightly from the normal) you will not be bothered with hum. With the half-mil stylus, the "Fluxvalve" reaches a new stage of perfection in the *Pickering* line of pickup equipment.

A final note on the half-mil stylus . . . as you can imagine, they are quite difficult to make and at the present time only myself and a dozen or so people (manufacturers, writers, etc.) have them. But production I am told, will make them available in fair quantity before too long. What about other manufacturers utilizing this half-mil stylus? Nothing to prevent them from doing so as long as their pickup unit has sufficient compliance. This may prove a stumbling block for all but a few of the very top-rated cartridges. At any rate, developments along these lines should prove rapid and interesting and I will report to you as soon as information is available.

I want to take this opportunity to wish all of you a Merry Christmas and a Happy and Prosperous New Year! I also want to thank all who have been kind enough to write me during the last year.

Equipment Used This Month: Pickering 350 "Fluxvalve" pickup, *Pickering* arm, *Components Corp.* turntable, *Marantz* preamp, 2 *McIntosh* 60-watt amplifiers, *Jensen* "Imperial" and *Electro-Voice* "Georgian" speakers. Tape equipment: *Ampex* 600 monaural, *Ampex* 612 stereo.

The opinions expressed in this column are those of the reviewer and do not necessarily reflect the views or opinions of the editors or the publishers of this magazine.

TCHAIKOVSKY

SLEEPING BEAUTY BALLET

Minneapolis Symphony Orchestra conducted by Antal Dorati. Mercury OL-3-103. RIAA curve. Price $22.98. Three discs.

With this release, *Mercury* completes its magnum issue of the three great Tchaikovsky ballets. In the previous "Nutcracker" and "Swan Lake," Dorati once again proved his affinity for, and mastery of, the ballet idiom. In this first complete and uncut "Sleeping Beauty," his brilliant reading should gain approbation from even his most severe critics who are wont to look upon Dorati's other efforts with jaundiced eye. From every aspect, Dorati turns in a stunning performance. His tempi, although faster than most, are not breakneck, his phrasing and orchestral balance are models of good taste, and best of all, the melodic line is not made subsidiary to Dorati's admitted proclivities for rhythmic drive. Each section of the score is made a sparkling vignette, but there is no feeling of discontinuity. Remarkable also, is the superb virtuosity of the Minneapolis orchestra. One would be inclined to think that after so much Tchaikovsky ballet in the previous recordings and in this, the playing might become somewhat stilted and mechanical. Not so here, as Dorati and his men always keep interest alive in this long score and with unflagging brilliance turn in what must be described as an orchestral "tour-de-force."

There may be die-hard critics who will still carp about Dorati's performance, but unless they have ears of solid tin, they must admit to the stunning impact of the sound of this recording. If the two previous recordings were hi-fi masterpieces, this is even more so. Possibly this attitude may be heightened by the fact that there is more opportunity for hi-fi razzle-dazzle in this score than in the "Nutcracker" and "Swan Lake." Or more than likely, it is the still more fabulous sound made possible by some modification in the famous *Mercury* single-*Telefunken* mike-over-the-podium pickup. I know there has been a modication . . . what it is I have not been able to find out as yet. Suffice to say that the strings are cleaner and more natural than ever, the vaunted *Mercury* percussion is of still greater impact and articulation, brasses have a brighter timbre, woodwinds a sweeter intonation. More spacious acoustics are evident, yet there seems to be no loss of inner detail, long a *Mercury* trademark.

(*Continued on page* 140)

Barbara Szygielski, Heath Engineering secretary, demonstrates ease with which variable tuning capacitors may be measured with the direct-reading checker.

A Direct Reading Capacity Meter

By J. FRANK BRUMBAUGH
Project Engr., Heath Company

Unskilled personnel can perform rapid and accurate capacity checks with this simple, foolproof tester.

THIS article describes a simple method by which capacity may be accurately measured, and the value in micromicrofarads displayed on a standard, linearly-scaled, meter. No operator adjustments, other than selection of the proper range, are required, since all capacity measurement is accomplished automatically by the instrument to be described. Operation of the "Direct Reading Capacity Meter" has been simplified so that accurate operation by unskilled personnel may be effected after less than two minutes of instruction. Thus, instruments of this type are finding increased usage in quality control, production line spot checking, tuned circuit alignment; in fact, in any application where the value of capacitance must be known accurately and rapidly, and particularly where cost precludes the use of expensive and complicated capacity bridges and highly skilled personnel.

For many years capacity has been measured by use of the time-honored bridge, a reliable and accurate but somewhat complicated procedure involving the adjustment of many dials, and the interpretation of a null upon either a galvanometer or by ear, using headphones. The latter method in particular is relatively inaccurate at best, due to the inability of the human ear to assimilate sounds lower in pitch than about 16 cycles-per-second. Too, the use of headphones becomes impractical in noisy locations, and most factory production lines are not noted for their low noise levels. While a capacity bridge is an excellent means for determining the value of an unknown capacitance, it is expensive both to buy and to operate. Due to its relative complexity, accurate operation requires both time and experienced personnel, and can easily exceed the cost of the component subjected to measurement.

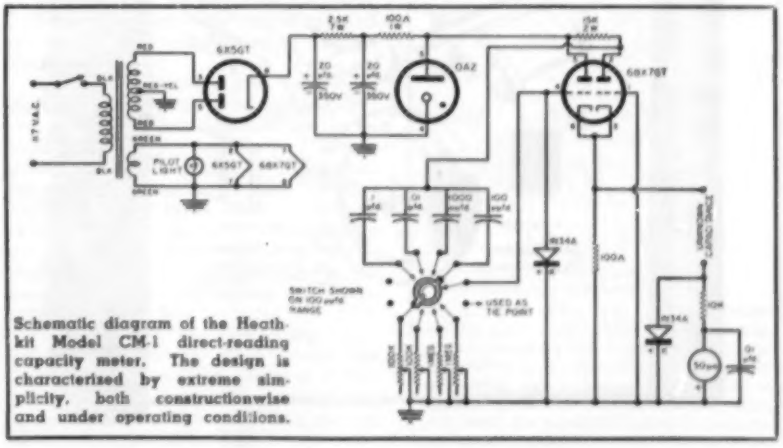
Recently, direct reading capacity meters of various types have been made available to industry. At least one of these meters, while quite accurate and fairly simple to operate, requires the investment of approximately two hundred dollars. It contains some ten tubes and measures capacity over the range of zero to 300 $\mu\mu$fd. Since it will also indicate the value of inductance up to 300 μhy., the initial cost may well be justified.

The Heath Company has long felt that industry needed a reliable, accurate, simple-to-operate direct reading capacity meter, which would also be inexpensive. The *Heathkit* Model CM-1 Direct Reading Capacity Meter is designed to meet this need.

A radical departure from the usual means of capacity measurement was indicated, if this need was to be met. The usual measurement methods had already been exploited to the utmost, and had been improved to the point of near-perfection. Obviously, something new had to be attempted, or something old unearthed, dusted off, and made to do new things. The circuit to be described is an interesting combination of both old and new and is made-to-order for the job.

A standard, a.c.-operated power supply delivers filtered d.c. to the voltage regulator tube, which is decoupled from the filter to prevent oscillation of the gaseous regulator, and the attendant instability of the regulated plate voltage. A 6X5 and 0A2, functioning as rectifier and regulator respectively, supply a constant d.c. voltage to the plates of a 6BX7. This tube is connected as a cathode-coupled, nonsymmetrical, astable multivibrator. One grid is clamped to ground through a type 1N34A germanium diode, preventing the grid from rising above ground

(*Continued on page* 132)

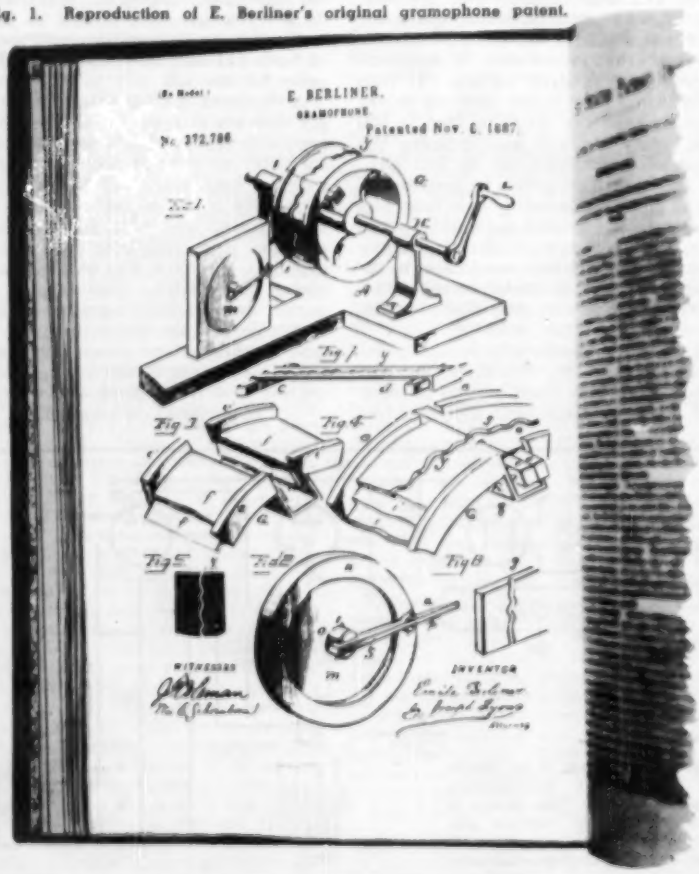


Schematic diagram of the Heathkit Model CM-1 direct-reading capacity meter. The design is characterized by extreme simplicity, both constructionwise and under operating conditions.

EVOLUTION of the

Emile Berliner at work in his modest laboratory experimenting with improved materials and techniques for making master recording discs.

Fig. 1. Reproduction of E. Berliner's original gramophone patent.



By
OLIVER READ
Editor, RADIO & TELEVISION NEWS
and
JAMES RILEY

TO Emile Berliner must go the credit for conceiving the phonograph record as we know it today. Born May 20, 1851, in Hanover, Germany, young Berliner came to this country in 1870. It was at the Philadelphia Centennial, in 1876, that Berliner first saw Bell's telephone on exhibit. He soon acquired a flair for things electrical and, in a house in Washington, set up a modest electrical lab. One of his experiments was an attempt to improve the telephone. He rigged up a diaphragm, battery and, in conjunction with a steel button, discovered that current would flow as various degrees of contact were made with his device. From his experiments the carbon microphone was developed.

He next directed his attention to the "talking machine" which had captured his fancy. He devised a disc record which worked on the principle of recording sound by cutting laterally on a rotating disc at an even depth.

Emile Berliner filed a patent application on May 4, 1887 for his "Gramophone" which was then patented on November 8, 1887. The significance of Berliner's patent to the phonograph industry is clearly revealed by reading from his original application as follows:

"This invention has reference to a novel method of and apparatus for recording and reproducing all kinds of sounds, including spoken words, and is designed to overcome the defects inherent in that art as now practiced and in the apparatus used therefor.

"By the ordinary method of recording spoken words or other sounds for reproduction it is attempted to cause a stylus attached to a vibratory diaphragm to indent a moving sheet of tin-foil or other like substance to a depth varying in accordance with the amplitudes of the sound-waves to be recorded. This attempt is necessarily more or less ineffective, for the reason that the force of a diaphragm vibrating under the impact of sound-waves is very weak, and that in the act of overcoming the resistance of the tin-foil or other material the vibrations of the

PHONOGRAPH

Part 2. The invention of the disc phonograph record and how it was responsible for the development of a multi-million dollar industry.

Fig. 2. Original Berliner hand-driven Gramophone. This is discussed in the article.

diaphragm are not only weakened, but are also modified. Thus while the record contains as many undulations as the sounds which produce it, and in the same order of succession, the character of the recorded undulations is more or less different from those of the sounds uttered against the diaphragm. There is, then, a true record of the pitch, but a distorted record of the quality of the sounds obtained. The simple statement that the material upon which the record is made resists the movement of the diaphragm is not sufficient to explain the distortion of the character of the undulations, for if that resistance were uniform, or even proportional to the displacement of the stylus, the record would be simply weakened, but not distorted; but it is a fact that the resistance of any material to indentation increases faster than the depth of indentation, so that a vibration of greater amplitude of the stylus meets with a disproportionately greater resistance than a vibration of smaller amplitude. For this reason loud sounds are even less accurately recorded than faint sounds, and the individual voice of a loudspeaker recorded and then reproduced by the phonograph cannot be recognized."

Berliner was referring principally to Edison's invention which employed the hill-and-dale technique.

"With a view of overcoming this defect it has been attempted to engrave instead of indent a record of the vibrations of the diaphragm by employing a stylus shaped and operating like a chisel upon a suitably-prepared surface; but even in this case the disturbing causes above referred to are still present. In addition to this, if in the apparatus of the phonograph or graphophone type it is attempted to avoid the disturbing influence of the increase of resistance of the record-surface with the depth of indentation or cut as much as possible by primarily adjusting the stylus so as to touch the record-surface only lightly, then another disturbing influence is brought into existence by the fact that with such adjustment, when the diaphragm moves outwardly, the stylus will leave the record-surface entirely, so that part of each vibration will not be recorded at all. This is more particularly the case when loud sounds are recorded, and it manifests itself in the reproduction, which then yields quite unintelligible sounds."

The preceding was directed to an explanation of the improvements made by Tainter and Bell on Edison's invention. Continuing with Berliner's application he states:

"It is the object of my invention to overcome these difficulties by recording spoken words or other sounds without perceptible friction between the recording-surface and the recording-stylus, and by maintaining the unavoidable friction uniform for all vibrations of the diaphragm. The record thus obtained, almost frictionless, I copy in a solid resisting material by any of the methods hereinafter described, and I employ such copy of the original record for the reproduction of the recorded sounds.

"Instead of moving the recording-stylus at right angles to and against the record-surface, I cause the same to move under the influence of sound-waves parallel with and barely in contact with such surface, which latter is covered with a layer of any material that offers a minimum resistance to the action of a stylus operating to displace the same, all substantially in the manner of the well-known phonautograph by Leon Scott. . . ."

Fig. 1 is a reproduction of the original Berliner patent. This patent has been broken down into several different sections, each identified by its own figure number. The following quoted

(*Continued on page* 149)

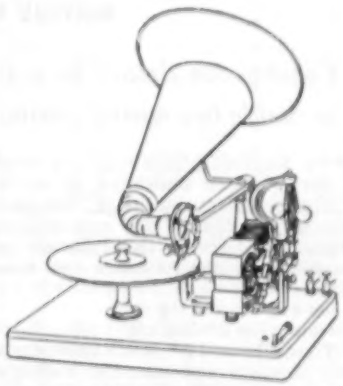
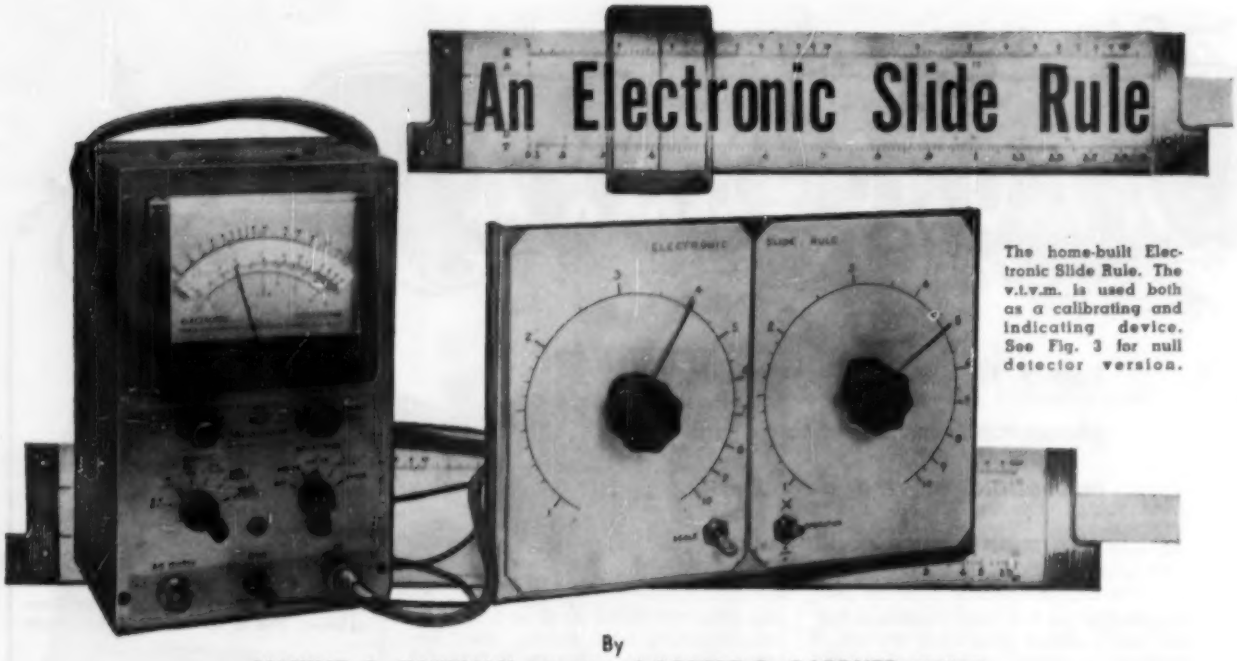


Fig. 3. The United States Gramophone Co. Model B "battery motor Gramophone." This unit was designed to be operated off one cell of a storage battery or a Grove or Bunsen cell. This unit sold for $25.00 plus 5 plates but without the battery.

Fig. 4. Sketch of the Type C "incandescent current motor Gramophone." This unit was manufactured by The United States Gramophone Co. of Washington, D. C. and was advertised as "a happy combination of hand machine with a standard motor." This unit listed for $50.00 including 12 records.

An Electronic Slide Rule



The home-built Electronic Slide Rule. The v.t.v.m. is used both as a calibrating and indicating device. See Fig. 3 for null detector version.

By
MAXIME G. KAUFMAN, W3OXT and ROBERT E. GARDNER, W3ODK

Construction details on a simple device which will multiply or divide two numbers using mechanical slide-rule principles.

THE Electronic Slide Rule is a simple device which multiplies or divides two numbers by using the same principle as that of the common mechanical slide rule. This principle can be stated by the following two equations:

$\log x + \log y = \log xy$

$\log x - \log y = \log x/y$

Thus, if we add the logarithms of two numbers and take the antilog of the sum, we will have the product of the two numbers. On the other hand, subtracting the logarithms of the two numbers and taking the antilog of this difference, yields the quotient.

This process is accomplished electrically in the Electronic Slide Rule by means of two linear potentiometers and a v.t.v.m. whose scales have been calibrated logarithmically. Although the pots used for the first model only yielded about 10 inches of scale expansion, "Helipots" (multiple turn pots) can be used which would yield the equivalent of a slide rule several feet long!

How It Works

The basic circuit is shown in Fig. 1. It can be seen that the meter will read the sum of E_1 and E_2, where:

$$E_1 = \left\{ \frac{R_2}{R_1 + R_2} \right\} B_1$$

and:

$$E_2 = \left\{ \frac{R_3}{R_3 + R_4} \right\} B_2$$

Let us say that we wanted to multiply two numbers, x and y. We would adjust R_1 and R_2 so that $E_1 = \log x$ and likewise adjust R_3 and R_4 so that $E_2 = \log y$. The meter would then read $\log x + \log y$, or $\log xy$. Since the meter scale is calibrated logarithmically, the meter will indicate the answer directly as xy.

The circuit can be made to divide as well, by merely changing the polarity of one of the batteries so that the meter will read the difference between the two voltages.

The Working Model

The schematic diagram for the Electronic Slide Rule is given in Fig. 2. The values shown were chosen to give an indication on the v.t.v.m. using a convenient scale, 10 volts in this case.

The components are not at all critical. Much lower voltage may be used if desired, depending on the v.t.v.m. used as the indicating instrument. This voltage should be high enough to deflect the meter to full scale. The resistors can have almost any value as long as they are high enough not to draw excessive current from the batteries and low enough so that they are negligibly small compared to the v.t.v.m.'s resistance.

A brief description of the function of each component follows: Referring to Fig. 2, R_1 and R_4 are used to adjust the voltage across R_2 and R_3 respectively, where R_2 and R_3 represent the two voltage dividers mentioned previously in Fig. 1. S_1 is the power switch. S_2 is the battery polarity reversing switch (for dividing), and S_3 is the scale switch, whose function will be fully explained later. In brief, its function is to keep the meter on-scale.

Calibration

Calibration of the instrument may be accomplished in several ways. The simplest is to use the v.t.v.m. as a standard. However, the accuracy of the unit can be no better than the accuracy of the meter. The procedure is as follows: Referring to Fig. 2, connect the v.t.v.m. to the output terminals. Then switch it to the 10 volt scale. Set S_2 to the "multiply" position and set S_3 to position A. Turn R_2 to zero and R_3 to the maximum position. Now adjust R_4 until the meter reads exactly full scale. Then return R_3 to zero and the meter should return to zero. This is the number one on the dial scale, which is being calibrated logarithmically. In short, 10 volts has been set up across R_3 and its dial face is ready for calibration.

The calibration process is straightforward. By the use of Table 1, all the numbers on the linear meter scale are projected to their corresponding antilogs on the new scale. In this case a paper face plate was pasted to the front of the meter glass for this purpose. Table 1 shows the values of the common (base 10) logarithms. For greater accuracy, or if smaller increments are desired, consult any table of common logarithms. Having thus calibrated the meter, set up 10 volts on R_3, as has been explained for R_3. It is now merely necessary to transpose each number of this new meter scale to each of the pots, namely R_2 and R_3. This is done by setting one of them to zero and then bringing the other one up slowly, stopping at each integer to

mark the dial plate. After this is done, repeat the process on the other dial plate.

To illustrate more specifically, a couple of calibration points will be demonstrated.

(*a*) Adjust R_2 to zero, set R_1 until the meter reads *log* 2 times full scale, or 3.01 volts, and put a mark at this pot setting. This mark will be the number 2 on the dial scale.

(*b*) Next adjust R_1 until the meter reads *log* 3 times full scale, or 4.77 volts. This pot position will be the number 3 on the dial.

Repeat this process on up to 10. Having thus calibrated R_1 on the right side of the instrument, set it to zero and set R_2 on the left side to maximum and repeat the calibrations.

It may be pointed out that any meter scale can be used for this instrument, as long as the calibrations are made in per-cent of full scale. An alternate method of calibration would be to measure R_1 and R_2 with an accurate bridge and then to divide up these resistances logarithmically. The meter, in turn, could then be calibrated from either pot as a standard.

Sample Problem

Now that the calibration of the slide rule has been discussed it is felt that a simple multiplication problem will demonstrate its operation, at the same time pointing out the scale-switch function more precisely. Say the product of 2 times 3 is required (Wow!). Set the left dial on 2 and the right dial on 3. Voltage will then be 3.01 volts at the left pot and 4.77 volts at the right pot. The meter will read their sum as 7.78 volts, but since the meter scale is calibrated logarithmically, it will indicate the number 6. The same procedure would be used for 20 times 3, but of course the user must supply the decimal point just as with the mechanical slide rule.

Suppose the product of 4 times 6 is needed. Here is a combination that will make the meter go off scale since it will try to read 6.02 plus 7.78, or 13.80 volts. This is where the scale switch comes into play. The switch action is the same as that of the mechanical slide rule when the right hand index on the C scale (slider) must be used instead of the left one. Simply throw this switch and the meter will read 3.80 volts, or the number 2.4 on the new scale, which is 24 when the decimal is considered. This operation can be expressed by the equation:

$$log\ x - (1 - log\ y) = (log\ xy) - 1$$

Substituting the values of 4 and 6 for x and y gives:

$$0.602 - (1 - 0.778) = 1.380 - 1 = 0.380$$

Since full scale on the meter is 10, the meter will read 3.80 corresponding to 2.4 (or 24).

The scale switch also functions properly when dividing. No mental effort is required in either case, since the switch is in the correct position when the meter is on scale. One point worth mentioning about the multiply-divide switch is that since the right-hand circuit contains this switch, the left-hand dial is the numerator and the right dial is the denominator.

Null Detector

For those who do not have a v.t.v.m. handy and since a high input impedance must be used to prevent loading, a null-indicator may be constructed as shown in Fig. 3. The dial of the potentiometer is calibrated logarithmically. This circuit is theoretically superior to the v.t.v.m. since it draws no current when balanced and also its scale can be made larger and thus more accurate. However, it necessitates the additional action of turning the knob of the pot and hunting for the null to find the answer. Incidentally, in order to protect the meter, R_3 is kept across the meter while a rough null is sought, and then removed by opening S_1 for the final, more sensitive null. A meter less sensitive than the 50-0-50 microammeter specified can be used without too much loss of accuracy.

(*Continued on page 78*)

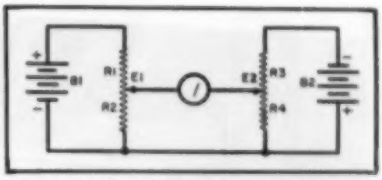
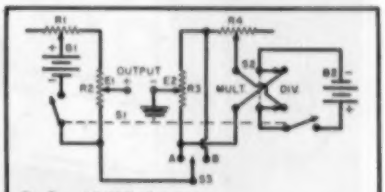


Fig. 1. The basic circuit of the Electronic Slide Rule. See text for full explanation.



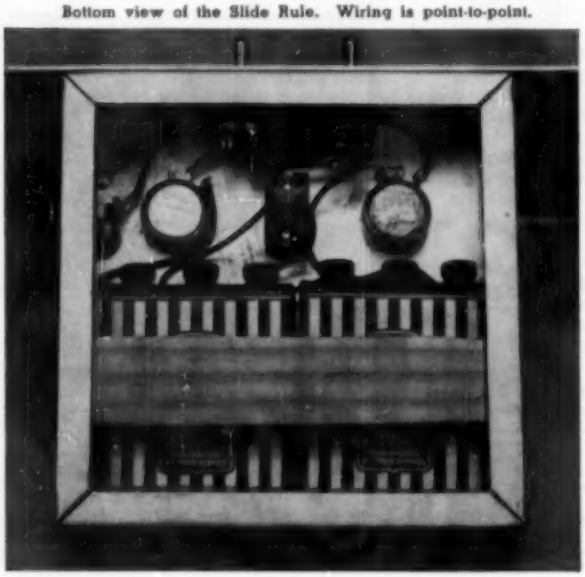
R_1, R_2—15,000 ohm pot
R_3, R_4—10,000 ohm wirewound linear taper pot
S_1—D.p.s.t. switch ("Power")
S_2—D.p.d.t. switch ("Operation")
S_3—S.p.d.t. switch ("Scale")
B_1, B_2—22½ volt battery

Fig. 2. Schematic diagram of the authors' working model of Electronic Slide Rule.

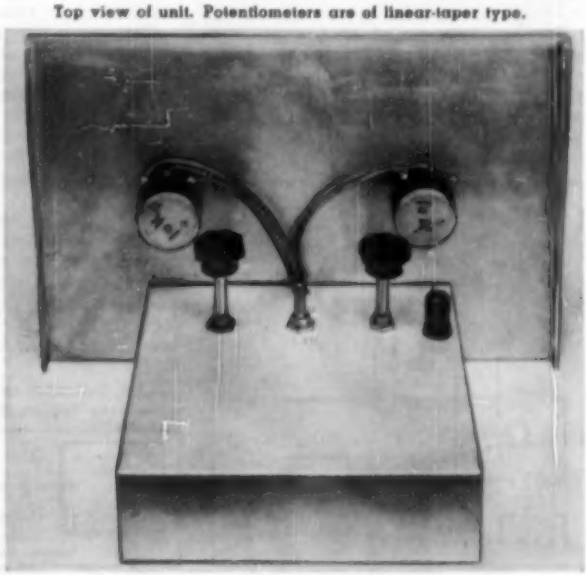
V.T.V.M. READING (volts)	NEW SCALE
0	1
3.01	2
4.77	3
6.02	4
6.99	5
7.78	6
8.45	7
9.03	8
9.54	9
10.00	10

Table 1. Table of values used in calibrating the meter when the 10-volt scale is used. Note that the v.t.v.m. scale values are 10 times the log of new scale values.

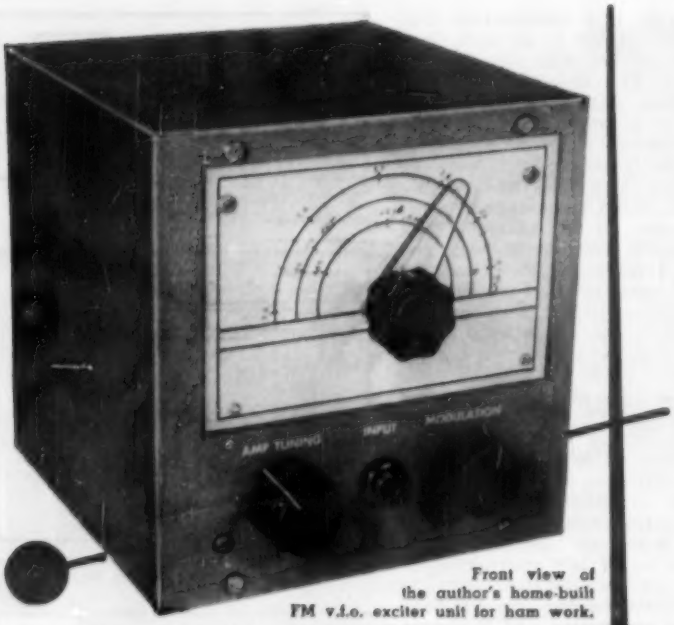
Bottom view of the Slide Rule. Wiring is point-to-point.



Top view of unit. Potentiometers are of linear-taper type.



A Novel Frequency Modulated V.F.O.



Front view of the author's home-built FM v.f.o. exciter unit for ham work.

An interesting, little-known characteristic of ceramics is utilized in this unique exciter circuit for ham use.

By
RICHARD GRAHAM
W2PDI

AN INTERESTING characteristic of certain "Hi-K" ceramic capacitors is that the exact capacitance value depends upon the voltage impressed across the capacitor. In ordinary bypass and coupling circuit applications, this small capacitance *vs* voltage change is insignificant and unimportant. But this fact can be utilized to produce a simple means of frequency modulating an oscillator.

It should be noted that capacitors using Type TC material for a dielectric do not exhibit this characteristic. *Centralab* states that, in general, ceramic capacitors with a tolerance of greater than 20% will be made of "Hi-K" materials; those with a tolerance of ±20% may be made of either "Hi-K" or TC materials, and those with a tolerance of ±10% or less will be made of TC material.

By placing an ordinary *Centralab* 500 $\mu\mu$fd. disc ceramic capacitor, such as the DD-501, in a test setup similar to Fig. 2, this voltage *vs* capacitance change can be observed.

This "non-linear" capacitor placed in the resonant circuit of an oscillator will produce frequency modulation. The tubular ceramic, DS-751, may also be used, but this component is rated at 750 $\mu\mu$fd., which would require some alterations in other circuit components in order to operate at the correct basic frequency.

The basic method of frequency modulating an oscillator with this capacitor is shown in Fig. 1. This circuit will be easily recognized as the familiar Clapp oscillator circuit except for the fact that the ceramic capacitor has been placed in series with the coil and tuning capacitor. Now the voltage change across the capacitor will result in a frequency change of the oscillator.

Fig. 1. Basic circuit of the FM v.f.o.

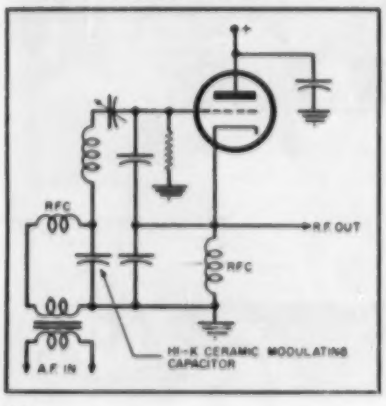
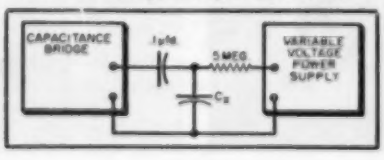


Fig. 2. Test setup for observing the capacitance vs voltage change. Refer to text.



In order to obtain a plus and minus oscillator frequency deviation corresponding to an audio input signal, it is necessary to "bias" the capacitor in the linear portion of the voltage *vs* capacity curve. Then by swinging the voltage plus and minus with an audio signal an approximately linear frequency swing of the oscillator results.

A practical application of the basic circuit just discussed as a frequency modulated v.f.o. exciter for ham use is shown in Fig. 3, and the accompanying photographs. The fundamental oscillator frequency is from 3.5 to 4.0 megacycles. The circuit is capable of approximately 5 kc. deviation even at the fundamental frequency. Of course, as the v.f.o. frequency is multiplied to other bands, the deviation is likewise multiplied by the same factor.

The capacitor bias voltage is determined by the plate voltage for the audio amplifier section of the 12AT7. In this case R_5 was varied to obtain a voltage of 160 volts at the plate of the audio section of the 12AT7 (pin 6) since this represents the center of the linear portion of the voltage-capacity curve of the ceramic capacitor. The choke RFC_1 and the capacitor C_{10} serve as an r.f. filter to prevent the r.f. voltage appearing across C_1 from getting back to the audio amplifier. At the same time this filter allows the audio variations at the plate of the audio amplifier to appear virtually unattenuated across the modulating capacitor C_1.

The oscillator tuning capacitor C_2 and trimmer capacitor C_3 serve another purpose beside that of frequency adjustment. Since the combined parallel values of these two capacitors is only 85 $\mu\mu$fd. maximum, they effective-

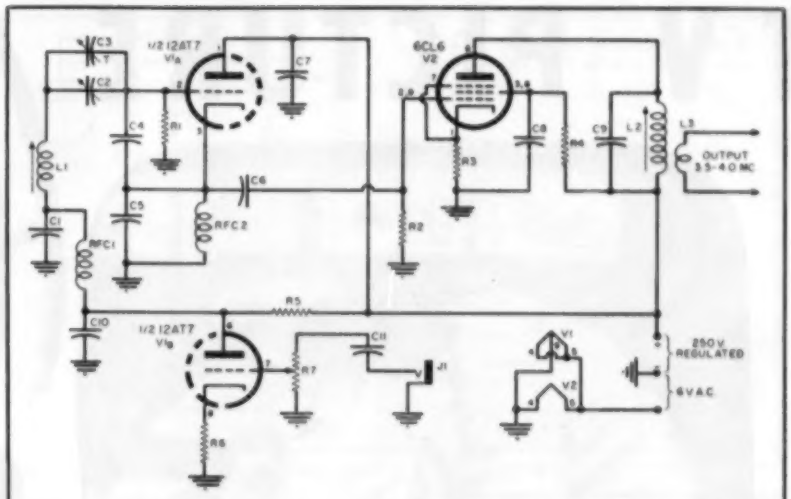
ly serve to keep the audio variations across the modulating capacitor C_1 from appearing at the grid of the oscillator. This prevents the oscillator from being amplitude modulated as well as frequency modulated. The audio isolation function of C_2 and C_3 appears to be satisfactorily fulfilled since tuning to the center frequency of the oscillator with an AM receiver results in an inaudible signal, indicating no AM in the oscillator output.

As in most stable oscillators and particularly in this design, the oscillator output is held quite low. This is to reduce the r.f. heating of the oscillator-tuned circuit elements and the resultant frequency drift of the oscillator. This particularly applies to "Hi-K" and bypass-coupling ceramic capacitors which normally are not used in oscillator circuits. It does not, of course, apply to temperature-compensating ceramic capacitors specifically recommended for oscillator circuits. These capacitors employ TC dielectric material and are extremely stable. A practical note to observe in this connection is that not all the ceramic capacitors tested resulted in the same degree of stability. Out of five capacitors tested, one was unacceptable, one was fair, and three were completely acceptable with regard to stability. This test can be performed by the constructor by adjusting the slug on L_1 to zero-beat WWV on a receiver. In this way the stability of any ceramic capacitor can be determined without too much difficulty.

The output from the oscillator is taken from the cathode of the 12AT7 and fed into the grid of a 6CL6 stage which is quite conventional in all respects and which serves to amplify and isolate the oscillator signal from any output load changes. The output is taken from the 6CL6 by means of three turns of hookup wire wound over the bottom end of L_2. This link connects to a length of 75-ohm ribbon which is coupled to the transmitter. The output is more than adequate to drive a 6V6 tube.

The control, R_7, at the input to the audio section of the 12AT7 serves as a deviation control. Since the amplitude variations at the plate of the audio amplifier determine the frequency swing or deviation of the oscillator, controlling the input signal to the audio amplifier also controls the deviation of the

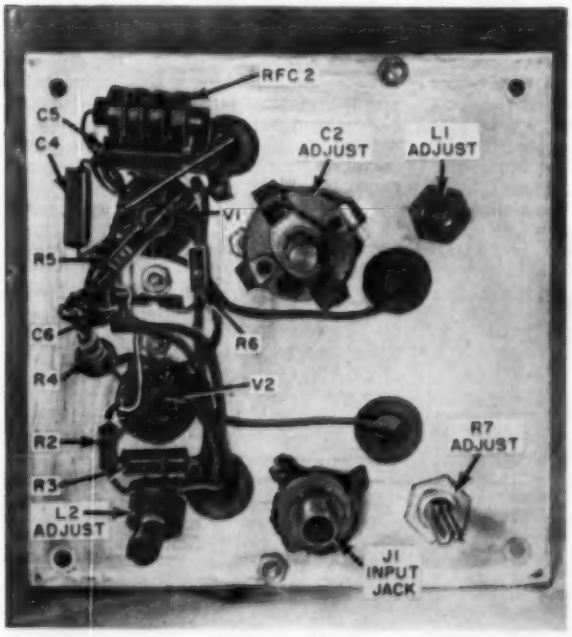
(*Continued on page* 105)



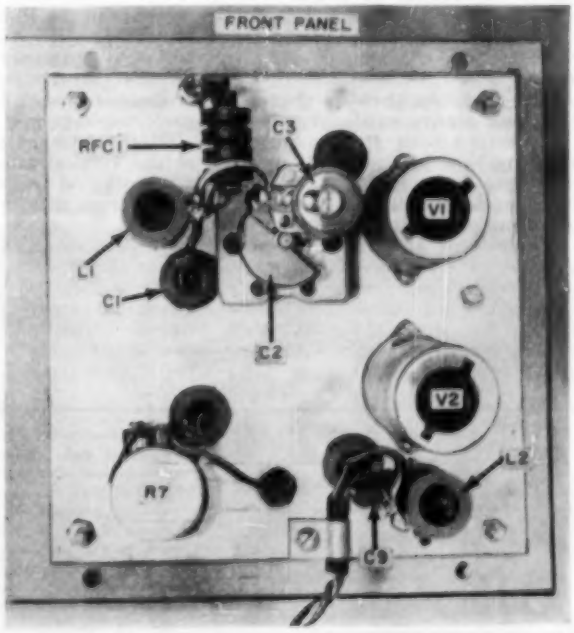
R_1, R_3—47,000 ohm, ½ w. res.
R_2—100 ohm, 1 w. res.
R_4—15,000 ohm, 1 w. res.
R_5—43,000 ohm, ½ w. res.
R_6—1200 ohm, ½ w. res.
R_7—100,000 ohm pot
C_1—500 μμfd. disc ceramic capacitor (Centralab Type DD-501)
C_2—35 μμfd. variable capacitor (Hammarlund HF-35)
C_3—5-50 μμfd. trimmer capacitor
C_4, C_7—500 μμfd. fixed mica capacitor
C_5, C_{10}—270 μμfd. tubular ceramic capacitor
C_6, C_{11}—.0015 μfd. disc ceramic capacitor
C_8—100 μμfd. fixed mica capacitor
C_9—.01 μfd. disc ceramic capacitor
J_1—Open-circuit jack
L_1—75 t. #30 en., closewound on ½" dia. slug-tuned form (National XR-50)
L_2—30 t. #30 en., closewound on ½" dia. slug-tuned form (National XR-50)
L_3—3 t. hook-up wire (see text)
RFC_1, RFC_2—2.5 mhy. r.f. choke
V_1—12AT7 tube
V_2—6CL6 tube

Fig. 3. Complete schematic of the FM v.f.o. utilizing the non-linear characteristic of a ceramic capacitor. The fundamental oscillator frequency is 3.5 to 4.0 mc.

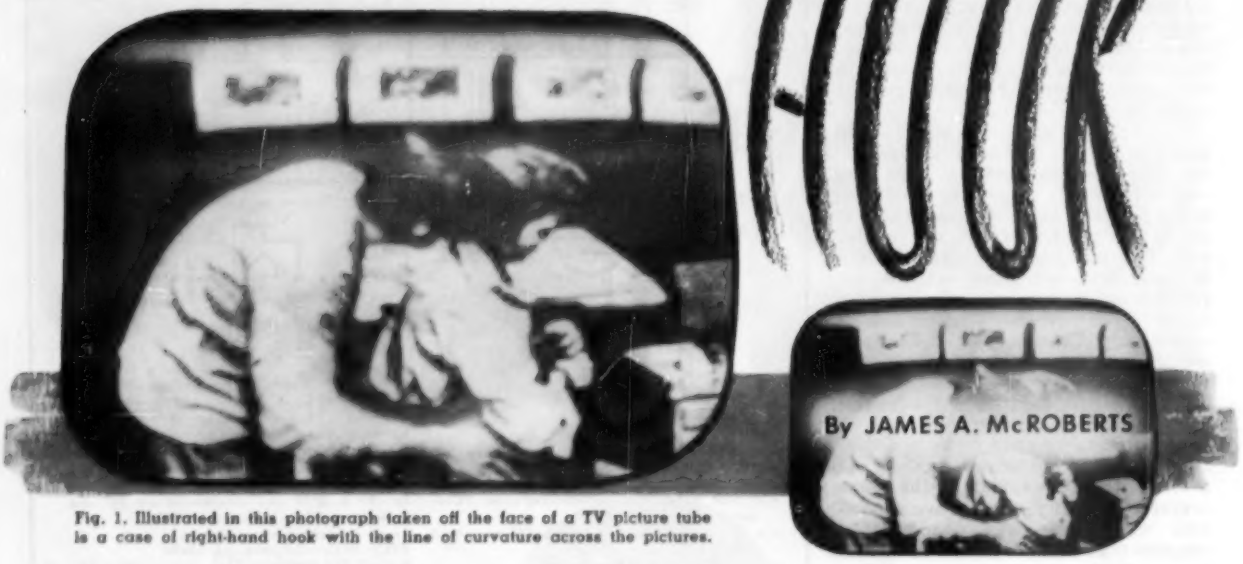
Rear view of the chassis with the components identified.



Front view of the chassis with the front panel removed.



TV PICTURE HOOK



By JAMES A. McROBERTS

Fig. 1. Illustrated in this photograph taken off the face of a TV picture tube is a case of right-hand hook with the line of curvature across the pictures.

Here's a trouble that is frequently found in older TV receivers. These service hints can save you benchtime.

THE commonplace symptom of hook has several aliases; it is known as top curve, top bend, wave at top, and crook, among others. Possibly this variety of names for the same thing is the reason for the variety of supposed origins and cures which are given for it. In this article the exact nature of hook will be shown, its primary and secondary causes will be given, and means for its cure will be considered.

Hook is both the trouble and the symptom. Figs. 1, 5, and 6 illustrate two forms of hook. As these photographs show, hook always exists at the top of the picture with strictly vertical lines being bent by the same amount in the same direction above some imaginary horizontal line of curvature. The amount of bending may vary from a mere detail of an almost unnoticed suggestion to a complete right angle, and the lines so bent may bend either as a straight line thereafter or as a curve. While straight vertical lines have been shown, all lines with some vertical component will have some bending. Another point is the uniformity of the symptom across the picture; all lines are bent by the same amount or angle.

A primary cause of hook is the feeding through to the horizontal section of the vertical pulse groups of the sync signal which occur during vertical retrace. Secondary causes might be the shift in the filter constants of the control line on sets equipped with horizontal automatic frequency control or shift in the integration network or associated parts furnishing the comparison voltage in a.f.c. receivers.

Of the primary cause, feedthrough of the vertical pulses, the horizontal differentiation network stops these pulses from getting to the horizontal output. The other primary cause is due to the upsetting of the "B+" supply by the change in current drawn at the time of vertical retrace, which may affect the horizontal oscillator; an electrolytic capacitor and a resistor prevent this trouble in normal set operation. Additionally, a.f.c. sets have a filter in their control lines from the a.f.c. comparison tubes or tube to the horizontal oscillator which serves as a further attenuator of the vertical pulse (sync) groups. Other causes and associated circuits will be discussed in conjunction with cures.

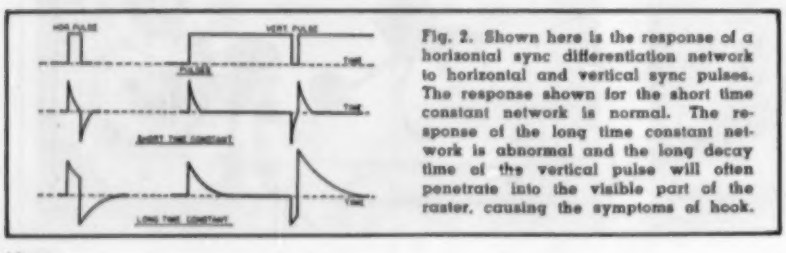


Fig. 2. Shown here is the response of a horizontal sync differentiation network to horizontal and vertical sync pulses. The response shown for the short time constant network is normal. The response of the long time constant network is abnormal and the long decay time of the vertical pulse will often penetrate into the visible part of the raster, causing the symptoms of hook.

Cures

Cures for hook, applicable to all sets will be treated first.

When hook is caused by excessive feedthrough of the vertical sync pulse group, the remedy is to shorten the time constant of the differentiator which acts as the horizontal sync pulse separator. Fig. 2 illustrates the differentiator action on both the horizontal and the vertical pulse groups, in part. Note the difference between the normal short time constant and the abnormally long time constant which can cause trouble. The trailing edges of the long time constant can build up to cause a vertical "bump" which can disturb the horizontal oscillator and cause hook.

To shorten the time constant of the differentiator reduce either the resistor or the capacitor of the *RC* circuit. Either of these units may have increased in value due to aging, however, resistors are more prone to such increases—test with an ohmmeter. Also, the resistor may be shunted with another resistor to reduce the time constant for a test. Replace the defective unit as a permanent cure since a changing part may keep right on changing and bring trouble again later.

Figs. 3 and 4 are partial schematic diagrams of the horizontal circuits of two TV receivers with a.f.c. The differentiator circuit components are

marked by the subscripts on the diagrams.

Sometimes the "B" supply carries a "bump" or pulse of voltage which shifts the phase of the horizontal oscillator to cause hook. The electrolytic capacitor may have decreased in value so that it can no longer adequately filter the pulses from the vertical output and the vertical oscillator. The test is simple, shunt the capacitor with another known to be in good shape. Remember that this shunting is a test only; cure by replacement of the defective part. The resistor may have lowered its value too, so you can check it with an ohmmeter.

Filter circuits in the horizontal oscillator control line are for the purpose of changing the choppy output of the a.f.c. comparer (phase detector and the like) to a smooth voltage to control the local oscillator. They serve additionally to filter out very low frequency disturbances like the 60-cycle "bumps" created by the vertical pulse groups.

These filters are almost always of two types, a series filter and a parallel filter. In practice, the series filter may split the parallel section into two parts as is shown in Fig. 4. To cure hook, either or both of these filter networks may be altered to increase their effectiveness at low frequencies—particularly to 60 cycles, and the components should be investigated to make sure that they have not changed in value thereby causing the trouble.

In Fig. 4, the series filter is denoted by R_a and C_a. In Fig. 3, there is no series filter. The parallel filter of Fig. 4 is denoted by the elements R_b and C_b separated by the series filter. In Fig. 3, there are several parallel paths of the filter to ground. The R_a-C_a path, and the resistance-capacity network in the remainder of the cathode circuit of the horizontal control tube serve as filters in part. Increasing the low frequency response of any of these filters will remove or partially remove hook.

Frequently, the addition of a capacitor, shown dotted in Fig. 3 as C_{add}, will remove the hook if it is not believed to be due to a defective part or component. It works well in this common type of commercial circuit. Another method is to increase the value of any of the filter components. Do not change the values of the components in the d.c. path to ground of the control tube of Fig. 3, however.

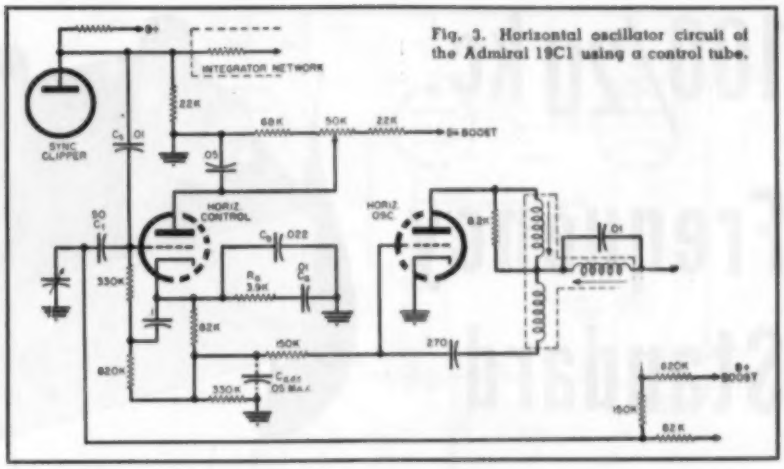


Fig. 3. Horizontal oscillator circuit of the Admiral 19C1 using a control tube.

Included in the circuit of Fig. 4 is another possible cause of hook. This is the comparison voltage fed back to the phase detector from the a.f.c. coil on the flyback transformer. This comparison voltage has a definite waveshape which may be upset by a change in voltage from the "B" supply. The voltage may be upset by even a slight change in the "B" supply if its integration circuit constants (the 12,000 ohm resistor and the .01 μfd. capacitor on the feed from the flyback to the phase detector) are improper. These constants shape the wave supplied by the a.f.c. coil (in some other commercial versions, the voltage is supplied from a width coil with a secondary winding) to that required for the proper comparison with the sync in the a.f.c. comparison circuit. Trouble can develop if the time constant is too great or too little, so in testing, both a series resistor and a shunt resistor should be employed.

Sometimes, a combination of cures will be found effective for difficult cases of hook. The differentiator may have its time constant reduced and, at the same time, the a.f.c. control line may be shunted to the chassis with a capacitor. Too, the "B" supply from the vertical may require attention in addition to feedthrough of the sync vertical group. —30—

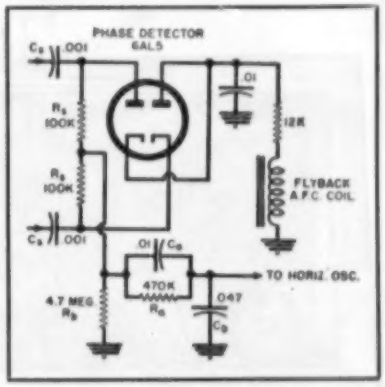


Fig. 4. Partial schematic diagram of the horizontal oscillator section of the Arvin TE 331 TV chassis employing a phase detector, showing the components which may go faulty, causing hook.

Fig. 5. Photograph of part of a TV screen showing a case of left-hand hook. Note the curvature of all vertical lines.

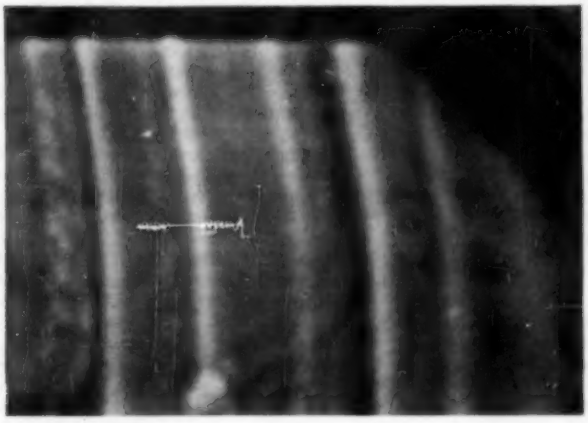


Fig. 6 Another case of left-hand hook combined with poor focus. This condition is often accompanied by instability.

100/20 kc. Frequency Standard

Top chassis view of the home-built 100/20 kilocycle frequency standard.

Under chassis view. Wiring is neat and uncluttered, parts well spaced.

By **WILLIAM L. BLAIR, W3ZKE**
Haller, Raymond & Brown, Inc.
State College, Penn.

Avoid "pink tickets" by checking your rig regularly with this inexpensive standard.

HOW often have you wondered just how close to the edge of the band you were operating or if maybe you were inviting an FCC "pink ticket" by transmitting outside the band because you were relying on receiver calibration? Many amateurs start out by figuring they will stay well within the bands in order to avoid illegal operation, but it's not long before they hear a "CQ" from one of those rare DX stations right about where they think the band edge is on their receiver dial. Then they think, "If only I knew this calibration was accurate!"

Ever been in this dilemma? Then take a look at the frequency calibration oscillator shown in Fig. 1. There is nothing tricky about this circuit but it is just the answer for a ham station with a receiver falling in the "less-than-$500" bracket. Here, with the simple flick of a switch, are calibration points spread across the frequency spectrum from 20 kc. to 30 mc. at intervals of 100 or 20 kc. Its construction is no task at all and its cost will be considerably under that of commercially available units whose check points have a fixed interval of 100 kc. only. Using them requires interpolation between points, but the calibration oscillator described here gives exact markers at 20 kc. intervals.

It will be seen in the schematic, Fig. 1, that the power supply is a simple half-wave rectifier circuit using a minimum of filtering since the total current drain by the oscillator is less than 10 ma.

The crystal is the largest single item investment in the unit, but should not run more than $6 to $8. It should be ordered for exactly 100 kc. The crystal is used in a standard electron-coupled oscillator circuit where positive feedback is from the screen to the grid. As you will notice, there are no tuned circuits anywhere in this unit, other than the crystal itself; consequently a highly distorted 100 kc. waveform is developed by the oscillator. This is just what we need, for such a waveform is rich in harmonics, which are usable through 30 mc.

S_1 turns the calibration oscillator on and off. It should be left in the "on" position while operating the receiver so that the heaters will be on and the oscillator ready for immediate use. S_2 is a double-pole, three-position switch with a "center-off" position. Normally, this switch will be in the off, or "stand-by," position when no output signal is desired from the calibrator, but in either the 20 kc. or 100 kc. position plate voltage is applied to both tubes through one pole of S_2. In the 100 kc. position the second pole connects the cathode of V_{2B} to ground through a cathode resistor R_{11}. Then the 100 kc. output pulses from the cathode of the oscillator, V_1, are amplified successively by V_{2A} and V_{2B} with the resultant output taken from the plate of V_{2B} through C_5.

It is not standard procedure to return the grid of an amplifier stage to "B+," but here it is necessary when S_2 is in the 100 kc. position, and R_{11} is chosen to limit excessive current flow through V_{2B}. Now, when it is desired to produce marker frequencies at 20 kc. intervals for more accurate calibration purposes, S_2 is thrown to the position marked 20 kc.

The two halves of V_2 are now connected in what is called a monostable, or "one-shot," multivibrator circuit. A

12AU7 tube contains the two triodes in one glass envelope. It will be noticed that two paths for coupling between V_{2A} and V_{2B} exist. Capacitor C_3 couples the plate signal of V_{2A} to the grid of V_{2B} while the common cathode resistor, R_5, provides the second path.

With no input signal to the multivibrator, the fact that V_{2B} has no bias (its grid is returned to "B+") causes a heavy plate current to flow through this triode. The same current flows through the common cathode resistor, R_5, and the resulting voltage drop places a bias on V_{2A} which is sufficient to cut its plate current off. This is the stable state of operation, hence the name "monostable" multivibrator. However, a second temporary state may exist. When a positive pulse from the oscillator hits the grid of V_{2A} it is amplified on its plate in the form of a negative-going pulse. This discharges C_3 and tends to decrease the current flow through V_{2B}. This also reduces the bias on V_{2A} being developed across R_5 and so causes the plate of V_{2A} to fall even lower. It is apparent that there is regenerative feedback and the result is a very rapid change of state to the condition where V_{2A} is conducting heavily while V_{2B} is cut off.

However, this state can exist only until C_3 can recharge through R_5 and R_6 to a point where the grid of V_{2B} goes above its cut-off value and V_{2B} starts to conduct again. Now the cycle is reversed and a very fast transition returns the two tubes to their original states. The larger the product of R_5 and R_6 times C_3, the longer the time required for the multivibrator to return to its original state following a pulse from the oscillator. The trick of frequency division now is to make this time equal in length to five times the interval between two oscillator pulses. Thus, once one pulse "triggers" the multivibrator, it is insensitive to the next four pulses. It then returns to its stable state and is ready to be triggered again by the very next pulse that comes along. The period, or cycle time, of the multivibrator is then five times that of the oscillator, or what is equivalent, the frequency of cycling of V_2 is $\frac{1}{5}$ that of V_1. Consequently, harmonics of the waveform at the plate of V_{2B} are spaced every 20 kc.

The end of resistor R_6, which is now connected to "B+," could have been connected to ground instead, but more positive action is achieved this way since the waveform on the grid of V_{2B} is steeper as it crosses the cut-off value of the tube in charging toward "B+" than it would be in charging toward zero.

Waveforms appearing at various points in the circuit are shown in Fig. 3. It was found in using the particular components listed in the parts list that the value of R_6 could be adjusted from 1.5 to 2 megohms and still maintain a frequency division of five. If it is so desired, a fixed resistor of approximately 1.8 megohms could be used if no oscilloscope is available for check-

(Continued on page 76)

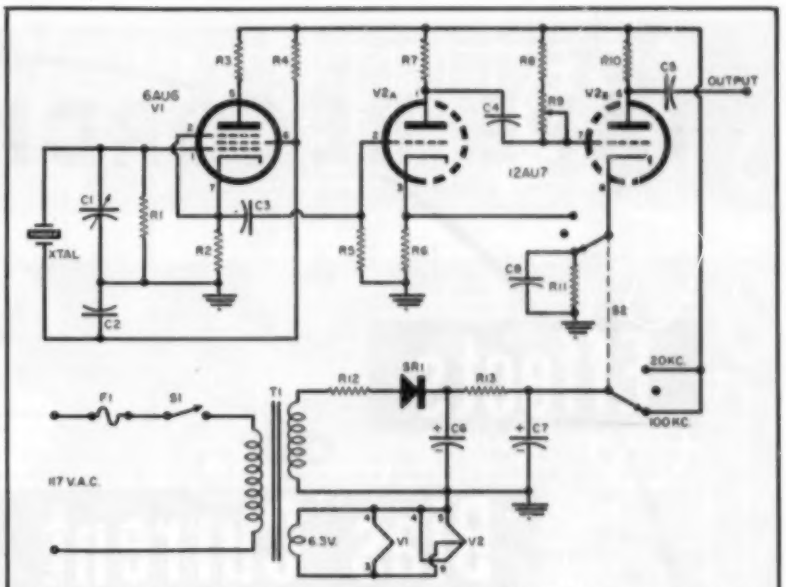


Fig. 1. Schematic diagram and parts list covering the 100/20 kc. frequency standard.

R_1, R_2—470,000 ohm, ½ w. res.
R_3—3000 ohm, ½ w. res.
R_4—150,000 ohm, ½ w. res.
R_5, R_7—100,000 ohm, ½ w. res.
R_6, R_{12}—1000 ohm, 1 w. res.
R_8—1.8 megohm, ½ w. res.
R_9—2 megohm, 2 w. pot
R_{10}—5600 ohm, 1 w. res.
R_{11}—10,000 ohm, ½ w. res.
R_{13}—30 ohm, 1 w. res.
C_1—50 μμfd. trimmer capacitor
C_2—150 μμfd. mica capacitor
C_3, C_4—20 μμfd. mica capacitor
C_5—100 μμfd. mica capacitor
C_6, C_7—40/40 μfd., 250 v. elec. capacitor
C_8—.001 μfd. mica capacitor
Xtal.—100 kc. crystal
F_1—¼ amp. fuse
T_1—Power trans. 117 v., 1:1 ratio, 6.3 v. fil. winding
SR_1—20 ma. selenium rectifier
S_1—S.p.s.t. toggle switch
S_2—D.p. 3-pos. (center off) toggle switch
V_1—6AU6 tube
V_2—12AU7 tube

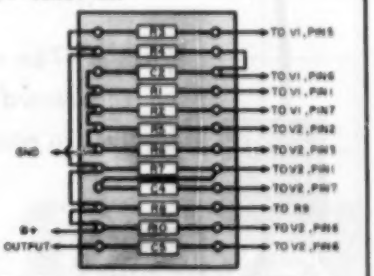


Fig. 2. Component mounting board layout for the home-built frequency standard.

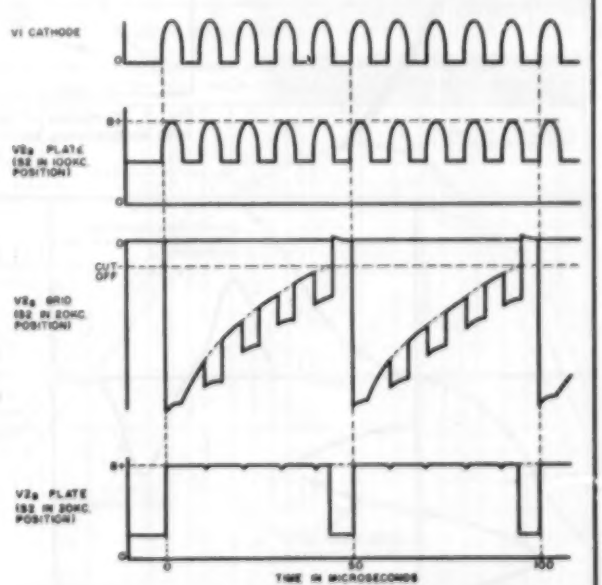


Fig. 3. Waveforms appearing at various points in the circuit of Fig. 1. If components specified are used, the builder can duplicate the results.

TAPE RECORDING

Effects of Bias Current

By **HERMAN BURSTEIN**

Part 4. The effects of a.c. bias current on the record head and the problems involved in equalizing frequency response.

THE previous articles in this current series on tape recording have covered the components of a tape recorder and their functions, the tape used in home recording, and the problems involved in record and playback losses. Another important item, that of a.c. bias current, will be covered in this article.

It has already been pointed out that a.c. bias current applied to the record head increases the recorded signal, reduces distortion, and has an erasing effect which is greatest at high frequencies. Because of the important role played by bias current and the problems it raises with respect to equalization of frequency response, amplification of the subject is warranted.

Various explanations have been advanced as to why a.c. bias increases output and reduces distortion. These explanations generally have reference to hysteresis curves and attempt to trace the complex magnetic behavior of the tape as it is subjected to the magnetic fields corresponding to audio signals and bias. No theory has yet accounted for all observed phenomena and won the acceptance of all authorities. However, from an empirical viewpoint the effects of bias are clear.

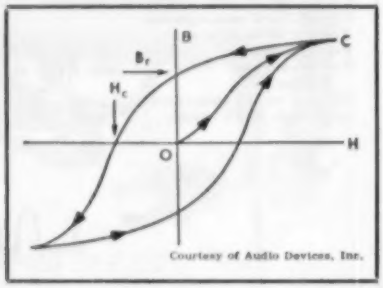


Fig. 1. Variation of magnetic induction (B) with magnetizing force (H). Refer to article.

Fig. 2 shows what happens when a sine wave is recorded without bias current and then played back. The transfer characteristic represents the relationship between input and output and is analogous to the transfer characteristic for vacuum tubes. It may be seen that the shape of this characteristic is similar to the start of the hysteresis loop shown in Fig. 1, which depicts the relationship between magnetizing force and tape induction. The input waveform appears on the vertical axis of Fig. 2 and the output (playback) waveform on the horizontal axis—in the usual manner for depicting the effects of a transfer characteristic. It is readily seen that although the input is a pure sine wave, the output is rich in odd harmonic distortion.

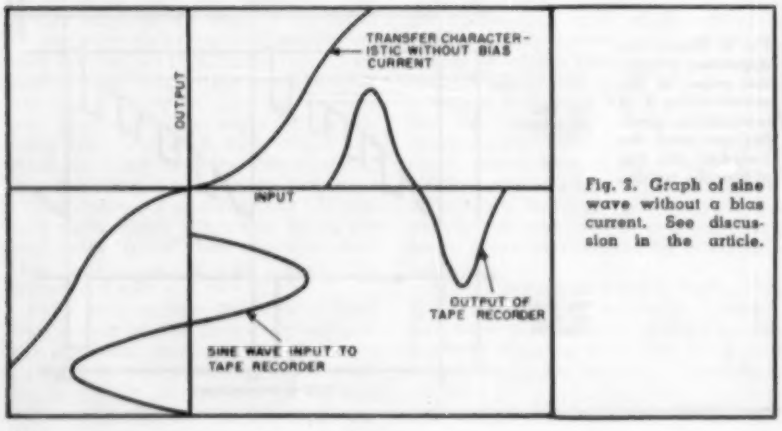


Fig. 2. Graph of sine wave without a bias current. See discussion in the article.

Fig. 3 shows how output of a single frequency, 1000 cps, varies with bias current when audio current to the record head is constant. Bias at first raises output greatly, but after a point an increase in bias contributes more to erasure than to output.

Fig. 4 is an elaboration of Fig. 3, showing for a number of frequencies how output varies with bias current. Maximum output is obtained with roughly the same amount of bias for frequencies up to nearly 1 kc. But this value of bias sharply reduces output at upper frequencies.

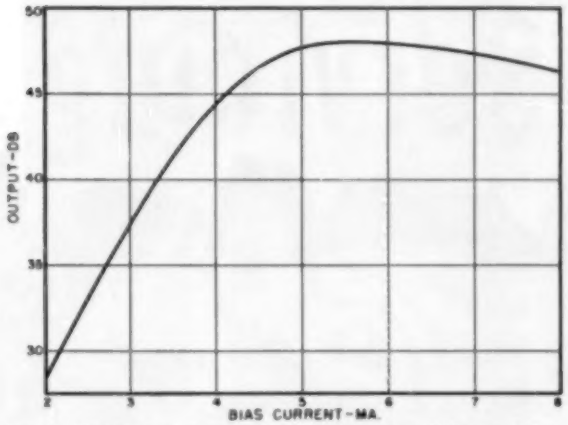


Fig. 3. Variation of output with bias current at 1000 cps. Information supplied by Minnesota Mining & Manufacturing Company. Data is for an Ampex Model 300, 15 ips speed, audio current to record head about 20 db below level producing one per-cent distortion, using the Scotch #111A type recording tape.

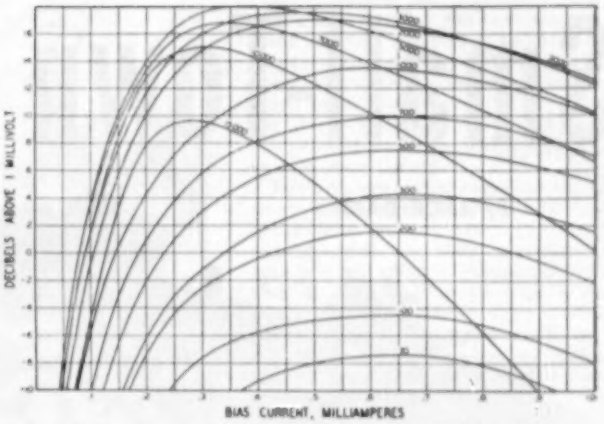


Fig. 4. Variation of output with bias current at different frequencies. Data is for a Brush BK-1090 head, with a 60 kc. bias frequency and a .08 ma. record current. Graph courtesy of Journal of the Audio Engineering Society, July 1953, "Structure and Performance of Magnetic Transducer Heads" by Kornei.

Fig. 5. Variation of distortion with bias current. Data is based on a tape consisting of red oxide on a plastic base, audio current at a high level. Courtesy of Audio Devices, Inc. "Fundamentals of Magnetic Recording" published in 1951.

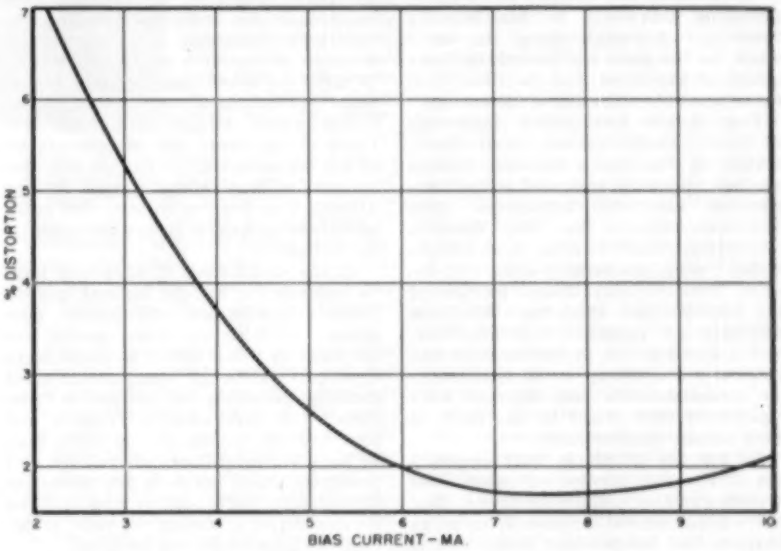
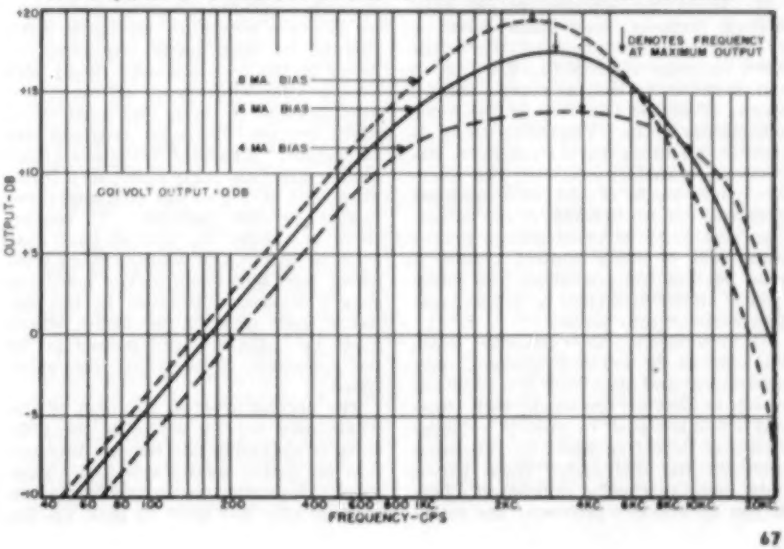


Fig. 6. Unequalized record-playback response of a record-playback head, operating at 7½ ips, for three values of the bias current. Refer to text for full discussion.



Proceeding to Fig. 6, it may be seen how unequalized record-playback response is affected by variation of bias current. The three values of bias current represented cover the practical range for the head in question at a speed of 7.5 ips. When bias is at the maximum value, output over most of the frequency range is highest. But treble losses are greatest when bias is largest. Also, maximum response occurs at a lower frequency. Thus a large amount of bias current necessitates a greater degree of treble equalization in order to achieve flat response.

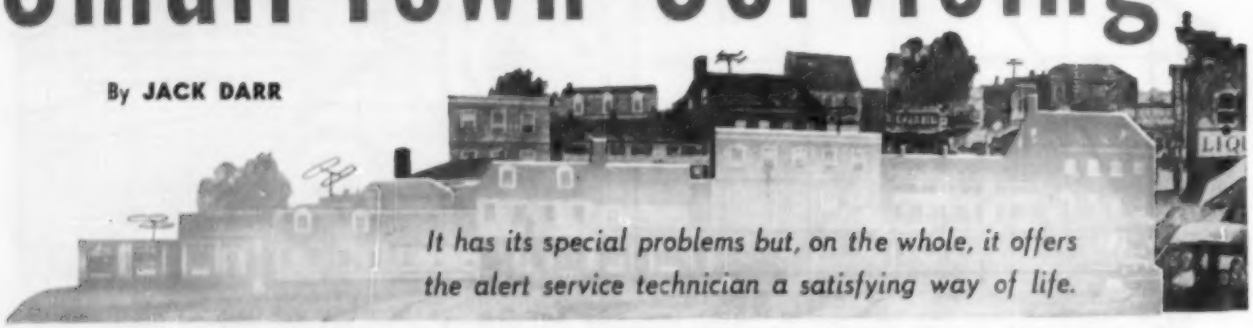
Although a large amount of bias substantially reduces high frequency response, at the same time it greatly reduces distortion, as indicated in Fig. 5. (Note that the actual amounts of bias current shown in Figs. 5 and 6 have no relevance inasmuch as each chart is based on a different head with different bias requirements.) Consequently it is necessary in the design of tape recorders to determine the optimum bias current, which represents the best balance of low distortion and extended high frequency response as well as high output. This is frequently done by setting bias so as to obtain maximum output at 500 or 1000 cps. Sometimes bias current is advanced slightly beyond this point. In some professional machines operating at 15 or 30 ips, where high-frequency response is no longer a serious problem, the practice sometimes is to use twice the bias current which peaks output at 1000 cps; thus distortion is kept very low.

Next month we will discuss the problems involved in equalization, the selection of equalizing circuits and related factors that must be considered.

(Continued next month)

Small-Town Servicing

By JACK DARR



It has its special problems but, on the whole, it offers the alert service technician a satisfying way of life.

THE radio and television technician operating in one of the many smaller towns of this country faces many problems unknown to his big-city brethren. Although doing the same work, on the same equipment, he lacks many of the helps and facilities that make the urbanite's life a bit easier.

Due to the tremendous expansion of rural electrification, even farmsteads in the more isolated regions possess television sets and other complicated electrical appliances once common only to the city dweller. Therefore, the rural-area service technician's shop has become a far cry, indeed, from the traditional picture of the neighborhood handyman, with one voltmeter, a carpenter's screwdriver, and a small bench in the back of the general store. Many small-town service establishments now operate with equipment that might be the envy of their urban counterparts.

As for the problems that confront the small-town service operator, first is parts stocking and procurement. Due to his geographical isolation from parts sources, the independent technician is forced to maintain a very large stock of parts and tubes. Where the city shop, with many wholesalers within easy driving distance, may stock three or so of each popular tube type, the small-town operator is forced to keep up to ten or more, as well as representative stocks of one or two each of the more uncommon types. The same thing is true of all other parts: resistors, capacitors, transformers, etc. The average parts stock of the well-equipped shop will run up to $2000 at net values. The possibility of obsolescence makes some sort of stock control system a vital part of the operation; too many "dogs" on the tube shelf or in the parts bins will cut into profits.

Unfortunately, the obsolete parts loss cannot be entirely avoided, only minimized, and then only if a constant watch is kept on the stock, with especial attention paid to prompt replacements of defective parts by returning them to the distributor from whom they were originally purchased. This brings up another problem: the selection of a good distributor. In the majority of cases, the small-town service dealer must do his parts buying by mail, or by ordering from the distributor's salesman, who makes an average of one trip every two weeks. It pays to select one reliable house, large enough to serve all the technician's needs, within reasonable distance of his town, and concentrate all of his business there. In this way, his account is large enough to gain prompt attention on regular orders, and extra attention on special orders for urgently needed parts.

In the small town it definitely pays to concentrate on the highest quality parts available for replacement purposes. Well-known brand names are an asset to the business in more ways than one. Although many places offer dazzling discounts and attractive "specials," the percentage of rejects and part failures among the bargains may be high. An established distributor will promptly make good on any defective high-quality parts sold by him, and the service dealer's "tie-up" of cash in defective parts is greatly reduced.

Summing up on the parts problem, therefore, would seem to indicate that the only solution for a small-town service dealer is a careful, intelligent analysis of his own parts requirements, based on his own business: what sets he services, what types of tubes are used in most of them, and what other parts require the most frequent replacement. A careful check will enable him to keep his parts stock to a minimum and still give his customers the fastest possible service. Of course, there is always the special part that must be ordered by long-distance telephone, and sent down on the bus: this entails an added expense in the author's town of $2.25 per order, which must be explained and passed on to the customer, if he wants the extra speed.

The second greatest problem of the small-town service dealer is the difficulty of obtaining late service information on newer model sets and equipment. A puzzled service technician in a large city has only to pick up the phone or drive down to the distributor of the set in question in order to get all the very latest data. But small towns generally do not have set distributors. One remedy for this is for the service dealer to be on the mailing lists of as many set manufacturers as possible. Almost all of them are glad to furnish service data on their late model sets, often free of charge. The major source of service data, of course, is the publishers who specialize in this field. It isn't possible to get too much information, in the author's opinion.

In many cases, the trouble lies not so much in the lack of detailed schematic diagrams of a particular set or circuit, but in a basic understanding of how some new circuit actually works. With rare exceptions, the small-town service technician is unable to attend the service meetings sponsored by manufacturer's representatives in the cities, although he will cheerfully drive a hundred miles to get to one, whenever he can. This leaves him with but one source of information on new circuits, new tubes, service techniques, etc., and that is the radio and television technical magazine!

Recently, some of the service data publishers have released small paperback books on servicing problems and circuit troubles of recent radio and TV sets. Where these are up-to-date, they are invaluable.

As a corollary to the points just mentioned it might be added that the average small-town technician must be better trained than his opposite number in the cities. Why? Because of his isolation; his distance from any source of technical help. Instead of telephoning for help on a puzzling set, he must either write to the manufacturer, with a possible delay of two weeks or so, or sit down and "sweat it out" unassisted. This usually leads to the eventual development of a better trained, more independent technician, because he has been forced to rely on himself alone for the solution of his problems. As a rule, the only help he has available is his competitors, most of whom will be around his own level of technical accomplishment.

Typical small-town service shop with big-city window-dressing ideas. Such small shops deal with their customers on a more personal basis than large city shops.

This situation is further aggravated by the fact that the rural service technician most of the time operates in a fringe area, both for TV and radio. This means that "halfway" service jobs are no good at all; to give any sort of performance at all, the sets he delivers must be capable of peak performance. The same sets, operating in primary TV signal areas, can fall off in performance to an astonishing degree before it becomes noticeable to the customer. The slightest difference is enough to cause trouble out in the fringe. This increases maintenance costs, of course, and also demands that the technician be sufficiently skilled to get this increased performance out of the set, by good service work and through the use of quality test equipment.

While on the subject of test equipment, the rural service shop must have plenty of it. Many small-town shops now boast of a lineup of test equipment that would put their big-town counterparts to shame. In test equipment, as in replacement parts, only the best equipment should be purchased—this includes kits as well as factory wired and assembled units. The added service life and accuracy of the high-quality instruments far outweigh their added cost. The author's shop contains a signal generator, for instance, purchased in 1940 for $81.00, a high price at that time. This instrument is still in daily use, has never been recalibrated, is still accurate, and apparently has several years of service left! Fifteen years of service without trouble is a good record, one which would be hard to duplicate with a cheaper instrument.

The small-towner, on a limited budget, needs to be very careful in his choice of test equipment, which often represents his largest single item of expense. Every single test instrument must be chosen on the basis of how much it will add to the shop's income. Everything in the place, including the Boss and the help, must pay its own way, or it has no business there!

One big problem, this one common to both the country resident and the city man, is the service charge schedule and the credit business. The average small-town shop will not be able to collect the same charge for his time as the urbanite; on the other hand, his lowered overhead expense will compensate for this. Typical service charges in the author's area are, for instance, $3.50 for a house call on TV, $1.00 for radio. If a set is removed to the shop, the minimum goes up to $5.00 for TV and $1.50 for radio. In the shop, jobs are charged on a prorated scale, based on a bench rate of $4.50 per hour. One advantage of the small-town operation is the comparative freedom from the $1.00 TV service call operators. As mentioned before, the small-town technician is either good, or he's gone. The "gyp" may show up in a small community, but he won't last too long, as a rule. The small-town man *lives* on repeat business. He has to, there is not enough totally new business to go around. Therefore, the "gyp" who gets all he can while the getting is good, does not last too long in the average small town, while the honest technician, who does good work and is willing to stand behind it, will continue to work and make a living.

Credit relationships in the small town are on an entirely different level from those of the city. Due to the more personal relationships and friendships existing between the small-town service dealer and most of his customers, refusal of credit sometimes becomes difficult. Far too many service dealers, eager to get on to the next job, will grant credit where credit is certainly not due. Many of the small towns have Credit Bureaus, which also serve as collection agencies.

Business operating expenses for the small-town service dealer can be much lower than in the city. By careful management, the shop operator can save a large amount, compared to the cost of operating an equivalent shop in the city. Due to the more intimate personal relations of the small town, a reliable service dealer can finance many things through the local bank, with a corresponding reduction in interest payments and difficulties often encountered with out-of-town finance companies. The officers of the bank can also serve as an invaluable source of credit information on various financial matters. For instance, radio and TV installment paper may be handled through the bank, at a saving to both the dealer and the customer.

Personal relations between competing technicians in the small town are generally better than elsewhere. They seem to realize that they're "all in the same boat" with regard to their problems, and consequently do all that they can to help each other out. This takes the form of loaning needed parts, technical help, etc. Cooperation of this kind makes life much easier for all concerned. For example, the author regularly exchanges "bad-risk" lists with his competition. This cuts down on the customer who runs up all his credit at one shop and, then, without paying, goes to another shop.

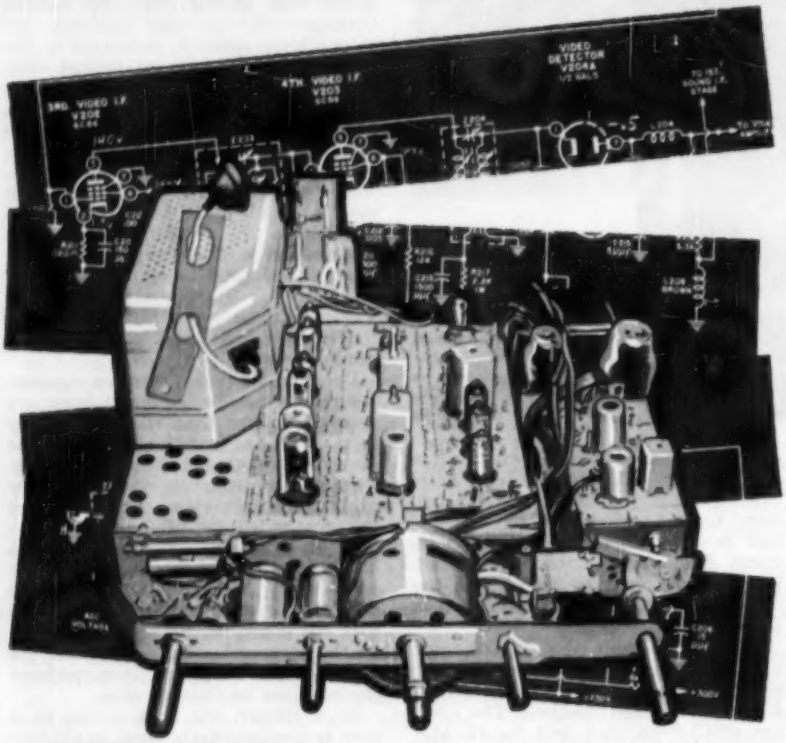
Even though the area served by a shop is predominantly rural in character, there is a surprising amount of other work, all electronic in kind, that can be obtained by the alert operator to fill up slack spots in his business. For instance, during the past year, the author serviced such items as Geiger counters, two-way radios, electronic organs, photoelectric gas-boiler control units, industrial r.f. heating equipment, high-fidelity amplifiers, tape recording equipment, moisture detectors, guitar-amplifiers, wireless phonographs, and public address equipment.

TV antenna work in the small town is usually a bigger business than in the "rabbit-ear" territory. The antennas are bigger and more expensive, and the installations more costly. For instance, the installation of a single-channel yagi antenna on a ten foot pole atop a house brings $50.00.

The technician who goes to the small town to make it his home must measure up to several qualifications. First of all, he must be a good, honest, well-trained technician, or be capable of becoming one. He must be able to assimilate himself into the community. The wise guy who comes to the small town to "take the Rubes" often leaves, sadder but wiser, after they've "taken" him! —30—

TROUBLESHOOTING TELEVISION I.F. STRIPS

By MILTON H. LOWE



Front view of G-E "EE" chassis showing video i.f. strip to the left of the tuner.

TV picture quality is determined in the i.f. strip.

Here is an analysis of its operation and servicing.

THE intercarrier i.f. strip and the video detector can be considered as the heart of the present day TV receiver, because it is here that the end products of video and audio are made or lost. This is assuming, of course, that the tuner has translated the desired channel down into the frequency spectrum of the i.f. strip. The i.f. strip is one of the more critical sections of the TV receiver because it is here that the "shaped response" is formed. One part of the problem is to keep the sound i.f. carrier at a considerably lower level than the picture i.f. carrier without attenuating it too greatly.

The intercarrier sound i.f. system, to review briefly, is one in which the picture and sound i.f. carriers are amplified in the same channel and, thus, both appear at the input to the video detector. The video detector, by virtue of its nature as a nonlinear circuit element, causes the picture and sound i.f. carriers to beat with one another. At the output of the video detector there appears, therefore, a 4.5 mc. signal (the difference between the two carriers) which is frequency modulated by the sound carrier and amplitude modulated, to a certain extent, by the picture carrier. This 4.5 mc. beat signal is the new sound i.f. carrier.

Most TV receivers obtain the required i.f. gain and passband by means of some type of stagger tuning. However, some sets, such as the *Du Mont* RA160 series, utilize over-coupled i.f. transformers. The schematic diagram of the i.f. stages and video detector of the *Du Mont* RA160 is shown in Fig. 1. Following the i.f. signal through the circuit, note that the input is applied to the junction of the two inductors that comprise Z_{206}. This tap is at a low-impedance point in the grid circuit of the 1st i.f. amplifier and is employed to minimize the loading effect on the grid circuit. It is a convenient point to which test equipment can be connected, for the same reason. The amplified output is applied through Z_{207} to the grid of the 2nd i.f. amplifier. Capacitors C_{205} and C_{206} prevent the a.g.c. potential from being shorted out through Z_{206} and the secondary of Z_{207}, respectively. The lower adjacent-channel sound trap comprised of L_{204} and C_{204} is connected to a low-impedance tap in the secondary of Z_{207}. As before, this technique minimizes loading of the grid circuit, as well as the possibility of the adjacent-channel sound signal radiating from the leads that connect the trap with the i.f. can.

The output of the 2nd i.f. is applied to the 3rd i.f. which, like the 4th i.f. stage, has a bypassed cathode resistor and does not receive a.g.c. voltage. Accompanying sound traps are located in the grid circuit of the 4th i.f. and at the input to the video detector. These 41.25 mc. traps attenuate the accompanying sound signals to prevent cross-talk (interference) with the picture signals.

The signal appearing across the secondary of Z_{208} is applied to the cathode of the video detector so as to maintain the negatively polarized transmission characteristics, and since the video detector conducts on the negative going portion of the i.f. signal, the output developed across R_{210} and L_{208} is negative in polarity. The network consisting of L_{208} and C_{210} is a low-pass filter that passes only the low frequency components of the detector's modulation products (*i.e.*, the video signals and the 4.5 mc. sound i.f. carrier) to the video and sound i.f. stages, as shown. The high frequency components, including the picture and sound i.f. carriers, are shunted to ground.

The 1st and 2nd i.f. cathode circuits are left unbypassed to provide a degenerative feedback that reduces the tendency for the input impedance of these stages to vary with changes in the a.g.c. potential. If this negative feedback were not employed to reduce this Miller Effect (as it is called), the grid circuit would become detuned with changes in a.g.c., and it would be almost impossible to align Z_{206} and Z_{207} correctly. This must always be borne

in mind while troubleshooting—never attempt to raise the gain of such i.f. strips by adding bypass capacitors to the cathode circuits.

The series-connected resistor combinations of R_{237}-R_{238}, R_{207}-R_{208}, R_{215}-R_{216}, all 15,000 and 12,000 ohm combinations, and R_{214}-R_{213} are very critical circuit components. They must be replaced by exact duplicates, and one resistor must not be substituted for the combination. The other circuit components whose values are critical are C_{228} and C_{229}. These screen bypass capacitors serve a dual function in that they act as neutralizing devices that prevent the 1st and 2nd i.f.'s from breaking into oscillation. This is accomplished by not fully bypassing the r.f. voltage at the screens of these amplifiers. The r.f. screen voltage cancels the signal which is fed back to the grid through the interelectrode capacity. If these capacitors must be replaced particular care must be taken to insure that exact duplicates are used.

If trouble were suspected in the i.f. strip—typical symptoms being low contrast, weak sound, snow, ghosts, sync troubles or combinations of these—a quantitative analysis of the performance of the stages could be obtained by voltage measurements. Most of these are shown in Fig. 1. They serve to indicate whether the tubes are conducting, and whether the components in series with the pin from which the measurement is taken and its "B+" tie point are open or hot.

For example, to take measurements in the 1st video i.f. the logical starting point (after first checking that the "B+" voltage is correct) would be the cathode circuit. Placing the v.t.v.m. on the lowest scale and connecting it to pin 2 of V_{205}, should give a reading of from 0.6 to 0.8 volt d.c. A reading greater than normal would indicate that excessive plate and/or screen current was being drawn. This could be due to an internal short in the tube, or in an external component, such as C_{229}. A much lower than normal reading might be due to a tube with low emission. A reading of zero volts could be due to an open cathode resistor or a completely dead tube.

The next step, that of checking the plate voltage, should reveal a reading of from + 125 to + 185 volts d.c. A low voltage reading could be indicative of an open primary winding in Z_{202}. This lower reading would be due to the added drop across the 33,000 ohm loading resistor in the i.f. can. A reading of about 216 volts on the plate of V_{205} would be obtained if no plate current were being drawn at all. The reason that 300 volts wouldn't be measured is because of the drop across R_{209} caused by the plate current of V_{205}. A short in C_{229} would cause a screen current of 6 milliamperes to be drawn (instead of the usual 2 milliamperes). This would cause the reading across R_{209} to jump to 0.9 volt, reason enough for taking accurate measurements where low values are concerned. A reading of −0.3 volt should be obtained on the grid as long as the a.g.c. is functioning properly and C_{229} is not shorted.

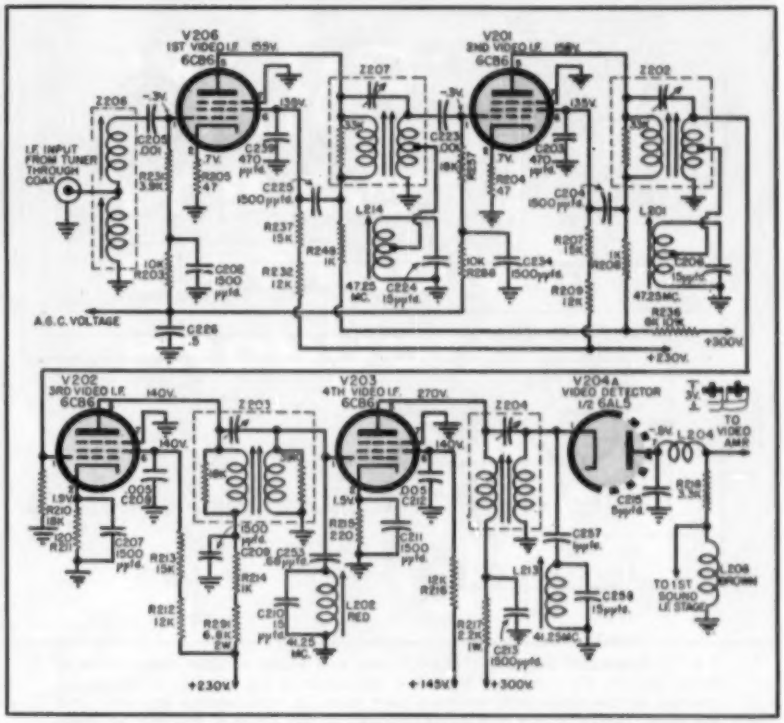
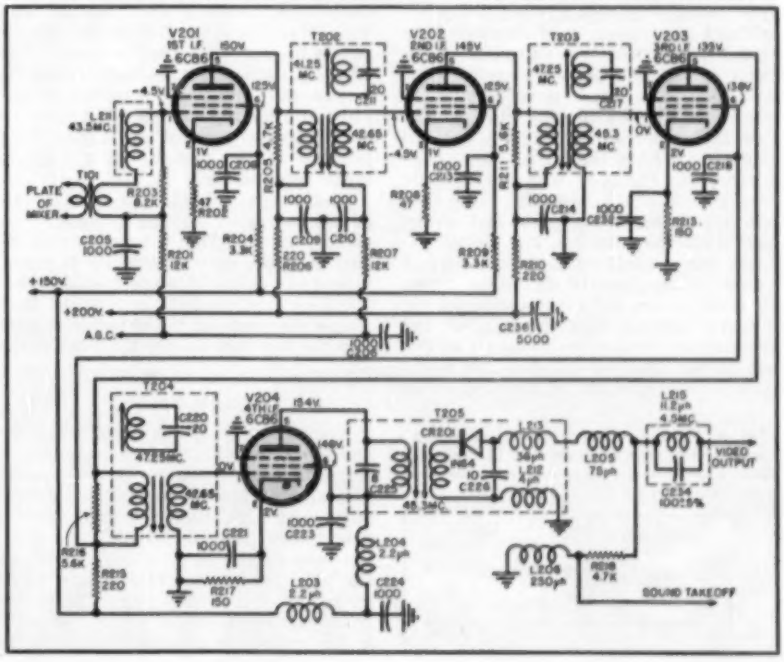


Fig. 1. Schematic diagram of the i.f. stages of the Du Mont RA160 series TV sets.

A second type of i.f. system is shown in Fig. 2. This is the simplified schematic diagram of a *Capehart* receiver using the "staggered-pairs" method of obtaining the required i.f. gain and passband. The staggered-pairs system is one in which a pair of i.f. coils is tuned to the low side of the picture i.f. center frequency and another set is tuned to the high side. A third coil, or set, is tuned to the center. In the circuit shown, the secondaries of T_{202} and T_{203} are tuned to 42.65 mc., the low side; and the secondary of T_{203} and the primary of T_{204} are tuned to 45.3 mc., the high side. The 1st i.f. coil, L_{201},

Fig. 2. The i.f strip and video detector circuit of Capehart CX series TV chassis.



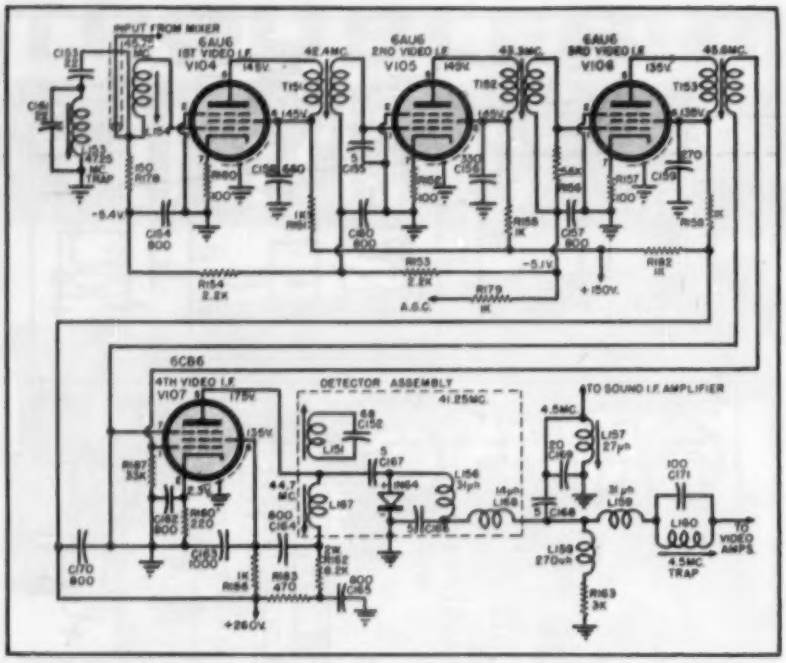


Fig. 3. Schematic diagram of the i.f. strip and video detector circuit used in many popular TV receivers. Note that the output of the i.f. strip is impedance coupled to the video detector since only three i.f. transformers are used and the mixer signal is not transformer-coupled to the input of the first i.f. tube.

is tuned to 43.5 mc., the center of the i.f.'s, to provide optimum signal input to the i.f. strip.

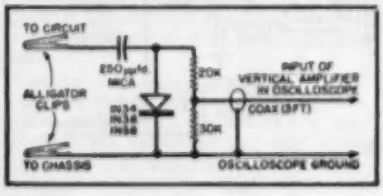
Note that the input to the 1st i.f. is by means of low-impedance, link coupling. The link is overcoupled to T_{1st}, the output of the tuner, so as to obtain a broad response. This method of low-fmpedance coupling is similar to that employed with the *Du Mont* receiver shown in Fig. 1. All the i.f. transformers are of the bifilar-wound type, which enables a near unity coefficient of coupling to be obtained. The bias for the first two stages is developed across unbypassed resistors, R_{3rd} and R_{2nd}. The a.g.c. potential, as in Fig. 1, is applied to only the 1st and 2nd i.f.'s. Continuing further, the 3rd and 4th i.f.'s are similar to their counterparts in Fig. 1 in that the cathode bias resistors are bypassed, and that the 3rd i.f. has lower plate and screen potentials than the 1st, 2nd, or 4th.

All these similarities in design and value of components should be borne in mind as an aid in troubleshooting. When a schematic is unavailable, the chances are that the i.f. circuit of the set to be serviced follows the trend and general pattern of the others of its type in the same price range and for the same year. Using the basic Ohm's Law technique to be described later the approximate correct circuit voltages can be determined.

A third type of i.f. amplifier strip is shown in Fig. 3. This is a straightforward stagger-tuned type. As with the staggered-pairs i.f. strip of Fig. 2, the i.f. coils are of the bifilar-wound type. In this case however, the transformers are single-tuned. The most striking difference between this circuit and the other two is that three stages obtain degenerative feedback by virtue of their unbypassed cathode resistors. Notice that the a.g.c. potential is applied to the first *three* i.f. stages to obtain greater control of the gain. This is done at the expense of a slightly lower over-all gain.

The output of the 4th i.f. is impedance-coupled to the plate of the video detector. This is necessary to insure that the correct polarity is maintained (*i.e.*, most i.f.'s use transformer-coupling throughout and with four stages the plate of the detector is usually the low side rather than the cathode).

Fig. 4. Typical demodulator probe circuit, useful for troubleshooting i.f. strips.



Troubleshooting

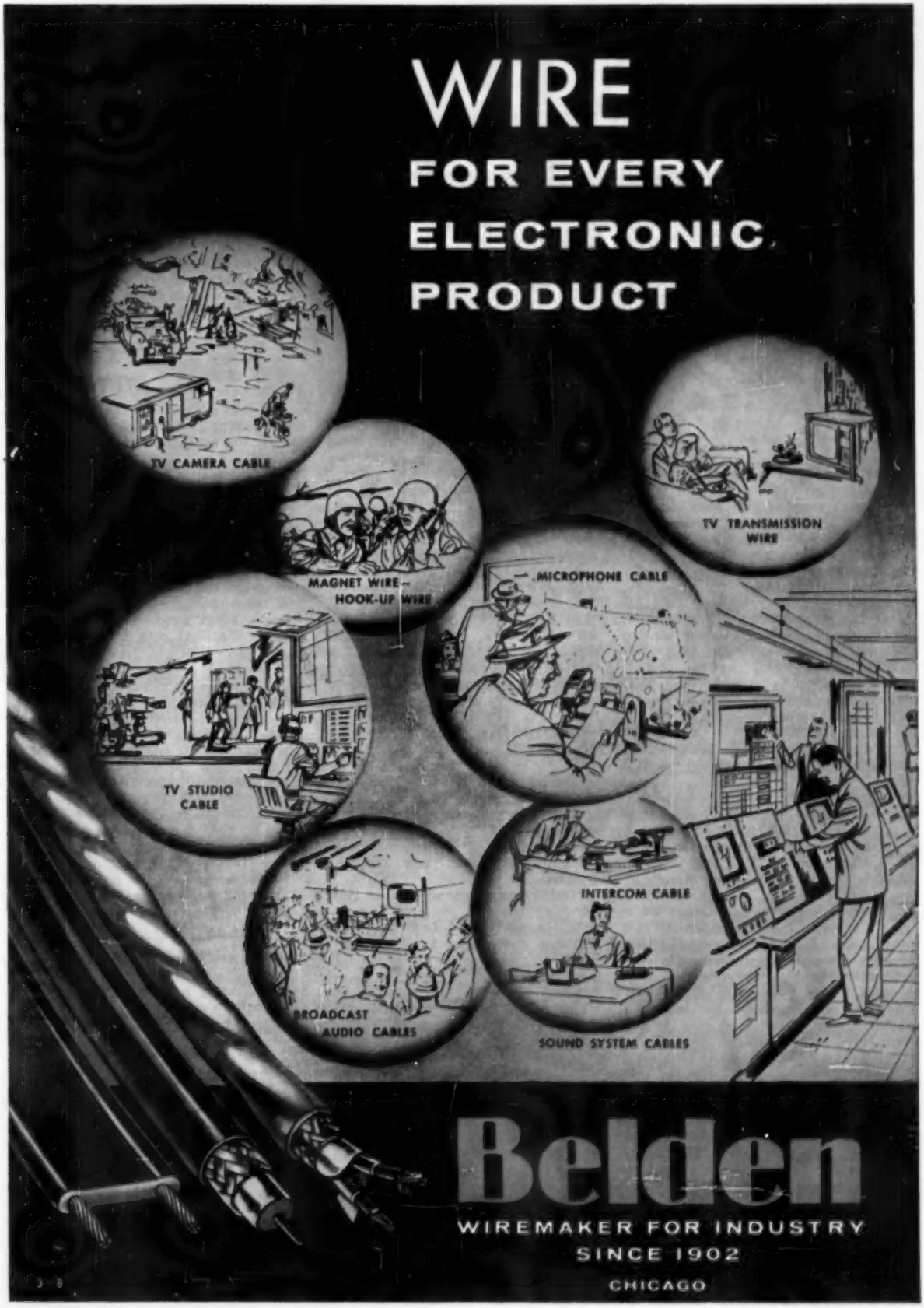
The best way to avoid trouble is by having the manufacturer's voltage and resistance chart handy, but if one is unavailable the voltage that should appear at each tube terminal can be determined by using Ohm's Law. Simply measure the "B+" voltage, calculate the total resistance between the point at which the measurement is to be made and the tie point where the voltage is known, determine the total voltage drop across the series components, and subtract this sum from "B+" to obtain the remainder that should be measured at the point in question. With a little practice this soon can be done mentally.

Where a qualitative analysis of i.f. bandwidth is required, one of the ways is to use an AM signal generator. Connect the generator to the r.f. mixer grid through a 1000 μμfd. capacitor and place a v.t.v.m. across the video detector load resistor. Remove the a.g.c. and set the generator to the picture i.f. center frequency. Adjust the output of the generator until a reading of 2 volts is obtained on the v.t.v.m. Now, varying only the frequency control of the generator, note the points on either side of the center frequency where the meter reading is 1 volt. These frequencies indicate the 6 db down points, and they should be about 1.9 mc. away from the center frequency on the low side, and 1.8 mc. away on the high side. By watching the meter while slowly varying the frequency control, any serious irregularities in the response curve can be noted.

Another way to check the i.f. strip is by means of an oscilloscope using a demodulation probe such as the one shown in Fig. 4. The procedure is first to check for video at the output of the 2nd detector using the scope only. The peak-to-peak amplitude of the signal should be approximately 3 volts. Now, using the scope and the probe, work backwards going from the cathode of the video detector to the plate of the 4th i.f., and so on. If a sharp decrease from normal gain is encountered look for a defective component.

A third way to check the i.f. strip is by means of signal injection. One of the quickest ways to determine which stage is defective is to again start at the last i.f. and work towards the 1st. This time use a metallic tool to touch *only* the grid of each stage. This will, in effect, amplitude modulate (with 60 cycles) the picture and sound i.f. carriers. If the audio detector is perfectly aligned, the characteristic 60-cycle hum may not be heard in the output. However, a pair of light and dark bands will appear on the CRT. The contrast of this set of horizontal bands will increase as this test is continued towards the 1st stage. As before, where the gain fails to increase as expected, trouble should be suspected.

A few tips to determine whether or not the i.f. strip needs realignment are in order. If the picture lacks contrast, but its resolution and quality are good, and there are no white-after-black or black-after-white smears, realignment is not required. If the picture quality is unsatisfactory and the fine tuning control has little effect on the picture quality, realignment is probably not required and the trouble is probably in the video amplifiers or output of the video detector. If the picture quality is unsatisfactory and the fine tuning control definitely affects picture quality, realignment is required. —30—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By JOHN T. FRYE

MAGNETIC SHIELDING

BARNEY came storming into the service shop out of the young blizzard whipping up outside. His spirits always accompanied the weather, and it was evident from his snapping blue eyes that he was really in high gear this December morning.

"Well what do you know!" he exclaimed as he pounced on a tall gold-colored metal cone resting on the service bench beside Mac, his employer, and began bellowing through it directly at the other's head. "You've been practicing up on your old high school yells. Sizz-boom-bah! Rah-rah-rah!"

"Quit yelling into my ear or I'll shove that thing down over your pointed little head clear to your shoulders," Mac warned.

"What is it?"

"It's a new magnetic shield for the cathode-ray tube of our old oscilloscope."

"Where did you get it? What's it made of? How come there's another smaller cone inside this big one?"

With a shrug of resignation Mac laid aside his tools. "I may as well tell you the whole story for there'll be no rest until I do," he sighed. "Bill Gardner, the purchasing agent at a local electronic factory, called me the other day and asked if I wouldn't like to sit in on a demonstration of a new magnetic shielding material that had been developed by the *Perfection Mica Company* of Chicago. He said his knowledge of magnetism was pretty shaky and that he'd like to have my opinion. I told him it would be a case of the blind leading the blind because I wasn't too hep on magnetism either; but I went, and I'm darned glad I did, for that salesman put on a real show. It was so convincing that I ordered this shield for our scope and these small square sheets of the magnetic shielding material with which to experiment."

"What's the stuff made of?"

"First, there is a base alloy of special formula steel with a low amount of carbon and manganese. A binder is applied to this and a special combination of ferrous and ferrite powders is flocked on. Finally a copper-ash coating is applied for electrostatic shielding."

"Sounds expensive."

"Well it's not—at least in comparison with the nickel alloy materials that have been used for this purpose. You see it is not only the cost of the material in the nickel alloys that makes them expensive, but after shields are formed from these alloys they must be annealed in a hydrogen oven. What's more, they must be handled with special care after annealing because they are shock sensitive. These new shields require no such expensive annealing or handling, and their cost is less than half that of nickel alloy shields."

"What do you mean by 'shock sensitive?'"

"A sharp blow or heavy jar will seriously impair the shielding qualities of a nickel alloy shield and make re-annealing necessary. Incidentally, so will subjection to a high-intensity magnetic field. This new material, it is claimed, is entirely free from these drawbacks."

"But does the new stuff do as good a job of shielding?"

"As far as I could see in the demonstration, it was actually superior on many counts, especially in shielding from d.c. fields."

"That salesman really did a snow job on you," Barney marvelled. "How did he do it?"

"With a large assortment of shields, a gauss meter, a two-inch unshielded scope tube, a collection of magnets, devices for generating a.c. fields, a compass—"

"Hold it!" Barney interrupted. "What's a 'gauss meter'? And shouldn't that word rhyme with 'hoss' instead of 'house'?"

"Nope, I've been mispronouncing it too; but a check with the dictionary proved the salesman had it right. A gauss meter is a device for measuring the strength of a magnetic field. I was curious about how this one worked; so I quizzed the man at some length and found the principle of operation is so simple that even you may be able to understand it."

"Try me," Barney urged.

"Fundamentally you have a small iron-core inductance, like say an 'Ouncer' audio choke, rotated by a constant-speed electric motor. Slip rings connect the leads of the inductance to a sensitive a.c. type v.t.v.m. As the inductance spins around in any magnetic field that may be present, the cutting of the magnetic lines of force by the turns of the inductance generates a voltage across the ends of the inductance that produces a reading on the scale of the v.t.v.m. By placing the inductance 'sensing' unit in d.c. magnetic fields of known strength, the scale of the v.t.v.m. can be calibrated directly in gausses. A voltage divider across the output of the sensing unit permits the meter to read a wide range of field strengths from a fraction of a gauss to several thousand gausses. One important point in design, though, is that the sensing unit must be shielded from the rotating motor. Placing the motor inside a small box made of the shielding material—which the manufacturer calls 'Fernetic Shielding'—took care of that.

"The salesman," Mac went on, "held a small Alnico magnet near the whirling sensing unit and got a reading of slightly less than 100 gausses; then, without moving the magnet, he slipped a small cylindrical shield of the Fernetic material over the sensing unit and the reading dropped to less than .5 gauss."

"That's surely chopping it down," Barney observed.

"Next," Mac continued, "he hauled out a large horseshoe magnet. It was a huge 22,000 gauss closed flux job, and it gave him a real wrestle to separate the keeper from it. When this magnet was held anywhere near the little two-inch CR tube, it promptly pulled the spot clear off the screen; but when the CR tube was placed inside two concentric shields and the giant magnet was placed directly against the outside shield, the spot barely shifted."

"Why two shields?" Barney wanted to know.

"I asked that, and the man explained that no one shield will do a good job of shielding against both high intensity and low intensity magnetic fields. A shield to be effective at low intensity must have high permeability; but at high intensity such a shield saturates and loses its effectiveness. In Fernetic Shielding the base material is designed to provide shielding against one intensity and the ferrous and ferrite coatings handle the other intensity—up to a point that is far beyond the scope of a single-material shield; but for maximum attenuation of an extremely strong field, such as that of the powerful magnet, double shielding provides six to eight times more attenuation. The high-intensity outer shield knocks down that 22,000 gauss field to one of only a few gauss; then

(*Continued on page* 136)

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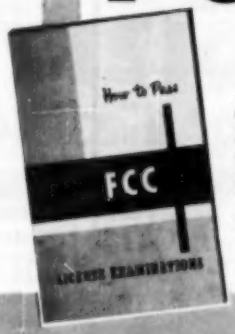

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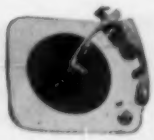

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Frequency Standard

(*Continued from page 65*)

ing its adjustment. Naturally, if the value of R_s is reduced below 1.5 megohms, the circuit will divide by four and give output calibration points every 25 kc.

A 5" x 9½" x 3" aluminum chassis was used. Fig. 2 shows the component location on the mounting board.

In the interests of economy, it is possible to eliminate the power supply completely and get the required 6.3 volts @ .8 amp. and 150 to 250 volts @ 10 to 15 ma. from the receiver itself. This should reduce the cost about 4 or 5 dollars and make it possible to build the calibrator on a smaller chassis.

Operation of the calibration oscillator is straightforward. It works well for the calibration of v.f.o.'s as well as receivers. As an example, let us assume it is desired to calibrate the 80-meter band of a receiver like the *Hallicrafters* S-53. We begin by turning on the receiver and calibration oscillator and tuning the receiver to a frequency of WWV, the National Bureau of Standards time station, which puts in a good signal at our particular location. The one broadcasting on 5 megacycles is best, for it falls within the same range as the 80-meter amateur band. Wait until the audio tone is removed from WWV and then tune the trimmer capacitor, C_t, until the 100 kc. oscillator "zero" beats with it in the receiver. S_2 should be in the 100 kc. position during this operation. At this point, any gross error in the receiver pointer position may be corrected by moving the pointer independently of the tuning capacitor until it lines up with the 5 megacycle marking on the dial.

Now, with the calibration oscillator output switch, S_2, still in the 100 kc. position, the receiver b.f.o. on, and the bandspread pointer at 100 (minimum capacity), tune the main tuning dial carefully until a zero beat is heard with the 100 kc. harmonic nearest to 4 megacycles.

Leave the main tuning dial set from this point on, throw S_2 to the 20 kc. position and tune the bandspread dial across the band. A zero beat will be heard spaced at 20 kc. intervals. If a strip of paper is taped across the dial it is then possible to make an ink mark at each point a zero beat occurs.

After this initial calibration procedure, it is only necessary to set the main tuning dial on the 4 mc. harmonic of the oscillator (with bandspread at 100!) each time it is desired to operate on the 80-meter band. If it is suspected that the receiver drifts gradually during operation it is wise to readjust the main tuning between QSO's.

It's as simple as that. For a relatively small investment and a little effort any amateur can have a receiver that is as accurately calibrated as those costing many hundreds of dollars! —30—

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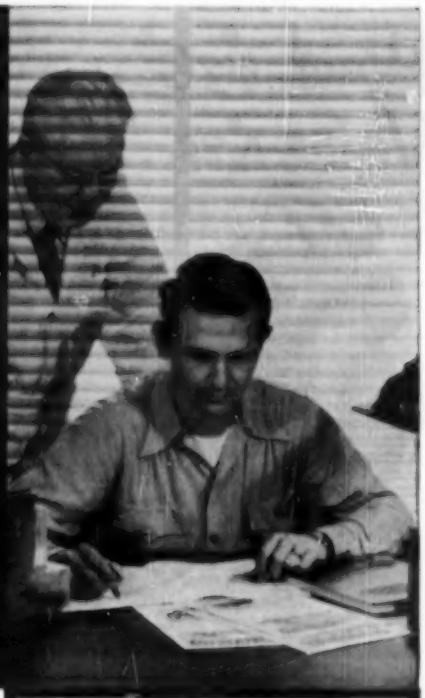

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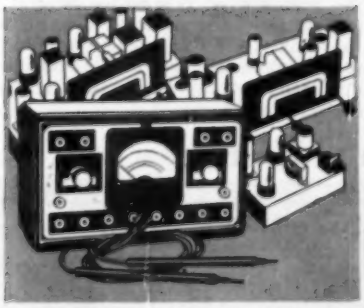

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Electronic Slide Rule

(Continued from page 59)

Powers and Roots

The additional operations of taking powers and roots can be performed using the basic circuits shown in Fig. 4. This is possible by using the relation:

$$\log x^n = n \log x$$

For n less than one, a gain of less than one is required, and a voltage divider may be used across one arm of the basic circuit, as shown in Fig 4A. For example, if R_a equals R_b, then:

$$n = \frac{R_a}{R_a + R_b} = 1/2$$

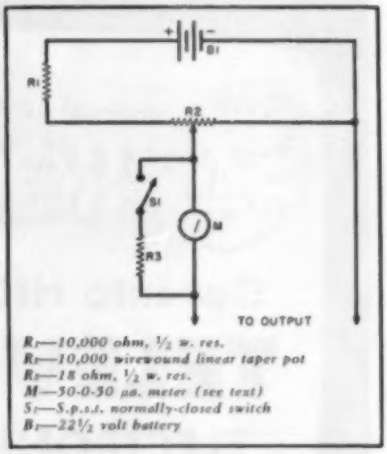
This means that the square root will be taken of any number set up on the R_a dial. A linearly calibrated pot can be substituted for R_a and R_b to allow a large choice of fractional values of n.

For raising a number to a power, the amplifier shown in Fig. 4B must have as much gain as is predicated by the maximum value of n desired. A typical value would be $n = 3$. The amplifier then must have a gain of at least 3, and it will then be able to raise a number to any power up to 3 by setting its gain. Although the basic circuit was shown to use d.c., a.c. can be used as well, which can be an advantage in this case, since it simplifies the amplifier design.

The alert reader will no doubt wonder about the meter reading as higher and higher powers are taken of a number, which, in effect, places relatively large voltages on the meter, causing it to go off-scale. This problem can be solved by inserting a suitable "bucking voltage" in series with the meter. The value of this voltage can be determined from the theory of logarithms, and will be found to be equal to the characteristic of the answer times the meter's full-scale voltage.

The following is a list of suggestions for those interested in experimenting further with the electronic slide rule idea:

1. Adding more arms to the circuit to handle more parameters.
2. "Helipots" for greater accuracy.
3. Concentric shaft, dual pots, for use on a single calibrated face.
4. Use of logarithmically tapered pots which allow linear scales on face plates.



R_1—10,000 ohm, ½ w. res.
R_2—10,000 wirewound linear taper pot
R_3—18 ohm, ½ w. res.
M—50-0-50 μa. meter (see text)
S_1—S.p.s.t. normally-closed switch
B_1—22½ volt battery

Fig. 3. Circuit diagram of the null-type indicator for use instead of a v.t.v.m.

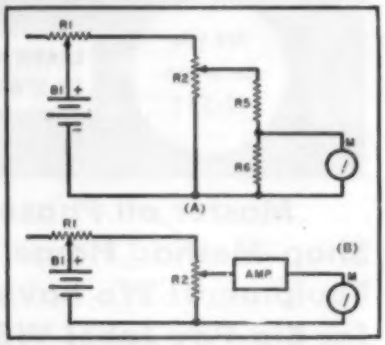
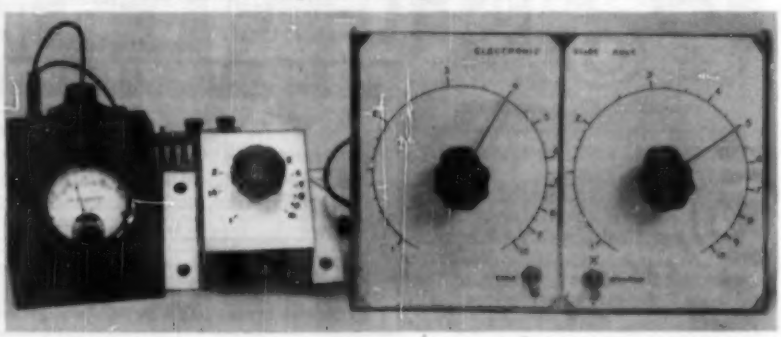


Fig. 4. (A) Basic circuit for taking roots of numbers. (B) Basic circuit of the system for raising numbers to powers. See text.

5. Switching S_a automatically at full scale.
6. Refinements in the system used for raising numbers to powers, including methods of switching in the bucking voltages.
7. Adapt the input arms to accept time-functions for studies of servo systems, and the like, with the output recorded.

No particular claim can be made for the accuracy of this device beyond 2 places, depending on what is used for the indicator. The over-all accuracy rests primarily on the calibration standard and the care taken in the calibration process. —30—

Use of the null detector, diagrammed in Fig. 3, in lieu of the v.t.v.m. See text.



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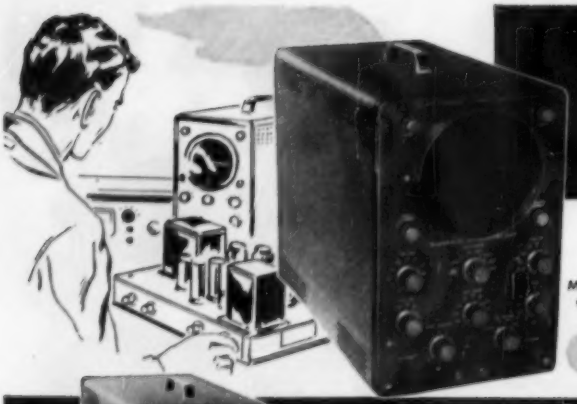

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Extend the usefulness of your Oscilloscope by observing modulation envelope of R.F. or I.F. carriers found in TV and radio receivers. Functions like AM detector to pass only modulation of signal and not signal itself. Applied voltage limits are 30 V. RMS and 500 V. DC.

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5 Heathkit ETCHED CIRCUIT 3" OSCILLOSCOPE KIT

This compact little oscilloscope measures only 9½" H. x 6½" W. x 11⅜" D., and weighs only 11 lbs! Easily employed for home service calls, for work in the field or is just the ticket for use in the ham shack or home workshop. Incorporates many of the features of the Model OM-1, but yet is smaller in physical size for portability.

Employing etched circuit boards, the Model OL-1 features vertical response within ± 3 db from 2 cps to 200 Kc. Vertical sensitivity is 0.25 V. RMS/inch peak-to-peak, and sweep generator operates from 20 cps to 100,000 cps. Provision for r.f. connection to deflection plates for modulation monitoring, and incorporates many features not expected at this price level. 8-tube circuit features a type 3GP1 Cathode Ray Tube.

MODEL OL-1
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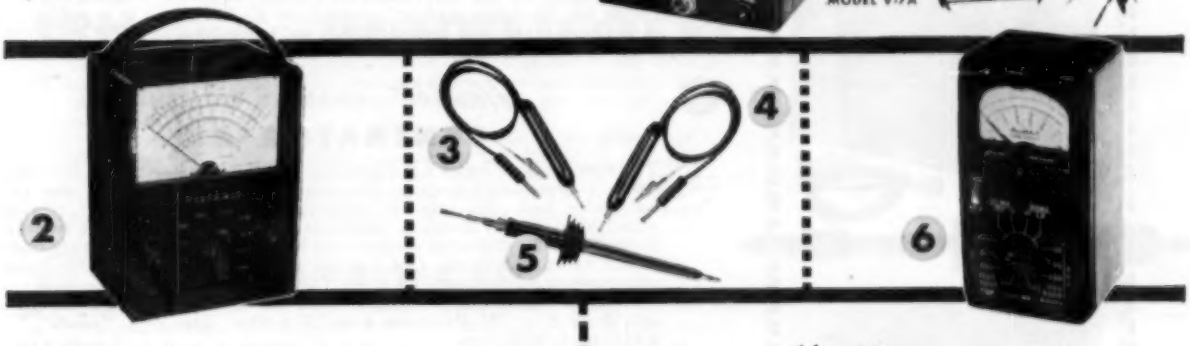

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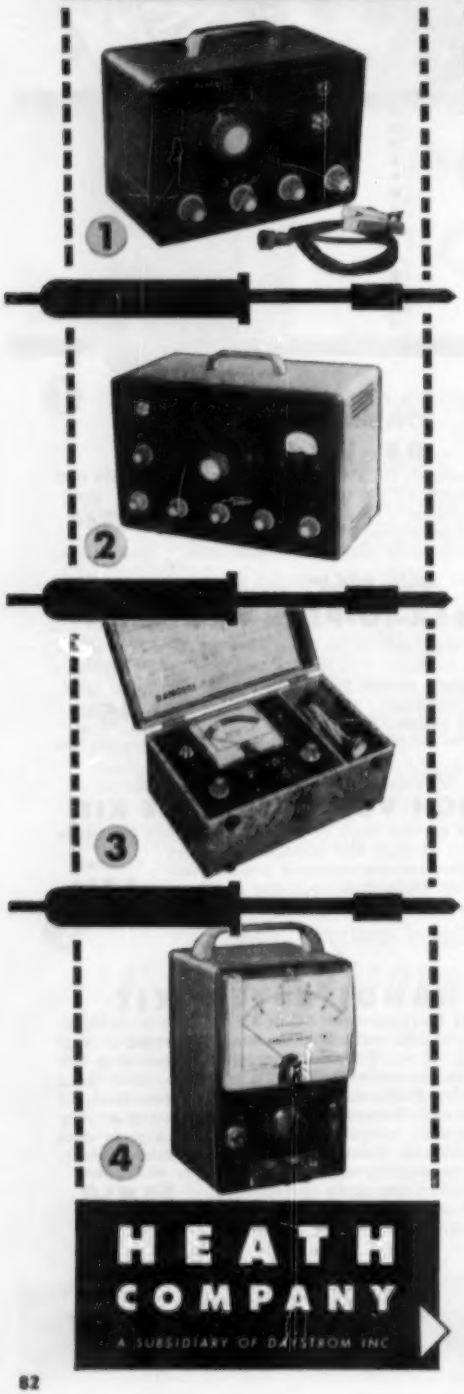
Heathkit TV ALIGNMENT GENERATOR KIT



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The new-design Model LP-1 produces vertical or horizontal bar patterns, a cross-hatch pattern, or white dots on the screen of the TV set under test. No internal connections required. Special clip is attached to the TV antenna terminals. Instant selection of the pattern desired for adjustment of vertical and horizontal linearity, picture size, aspect ratio, and focus. Dot pattern presentation is a *must* for color convergence adjustments on color TV sets.

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3 Heathkit CATHODE RAY TUBE CHECKER KIT

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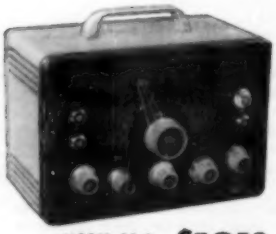
Heathkit SIGNAL GENERATOR KIT



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Tests vibrators for proper starting and indicates the quality of the output on a large "GOOD-BAD" scale. Checks both interrupter and self-rectifier types in 5 different sockets. Operates from any battery eliminator delivering variable voltage from 4 to 6 volts DC at 4 amps. Ideal companion to the Model BE-4.

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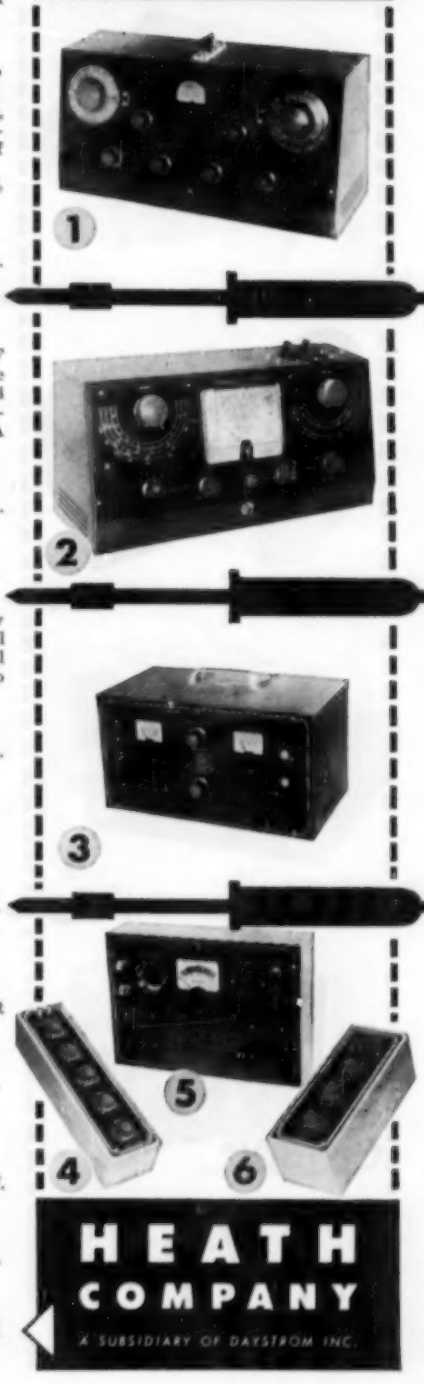
Shpg. Wt. 6 Lbs.

6 Heathkit DECADE CONDENSER KIT

Provides capacity values from 100 mmf to 0.111 mfd in steps of 100 mmf. ± 1% precision silver-mica condensers used. High quality ceramic switches for reduced leakage. Polished birch cabinet. Extremely valuable in all electronic activity.

MODEL DC-1
$16.50*
Shpg. Wt. 3 Lbs.

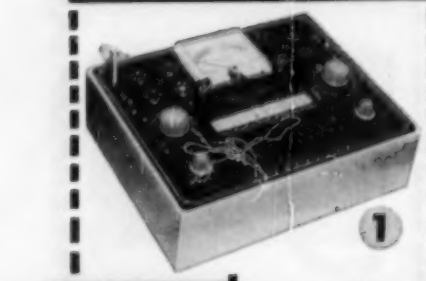


HEATH COMPANY

A SUBSIDIARY OF DAYSTROM INC.

BENTON HARBOR 15, MICHIGAN

Heathkit TUBE CHECKER KIT



1 The Heathkit Model TC-2 is an emission type tube tester that represents a tremendous saving over the price of a comparable unit from any other source. At only $29.50, you can have a tube tester of your own, even if you are an experimenter, or only do part time service work. Extremely popular with radio servicemen, it uses a 4½" meter with 3-color meter face for simple "GOOD-BAD" indications that the customer can understand. Will test all tubes commonly encountered in radio and TV service work.

Ten 3-position lever switches for "open" or "short" tests on each tube element. Neon bulb indicates filament continuity or short between tube elements. Line adjust control provided. The roll chart is illuminated.

Sockets provided for 4, 5, 6, and 7-pin, octal, and loctal tubes, 7 and 9 pin miniature tubes, and the 5 pin Hytron tubes. Blank space provided for future socket addition. Tests tubes for opens, and shorts, and for quality on the basis of total emission. 14 different filament voltage values provided.

MODEL TC-2
$29.50
Shpg. Wt. 12 Lbs.

2 Heathkit **PORTABLE TUBE CHECKER KIT**

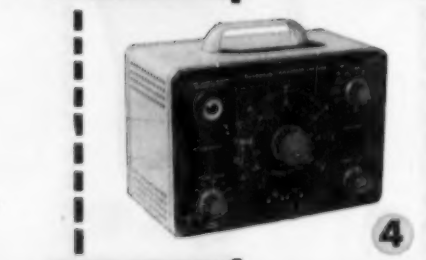
The Model TC-2P is identical to the Model TC-2 except that it is housed in a rugged carrying case. This strikingly attractive and practical two-tone case is finished in proxylin impregnated fabric. The cover is detachable, and the hardware is brass plated. This case imparts a real professional appearance to the instrument. Ideal for home service calls, or any portable application.

MODEL TC-2P
$34.50
Shpg. Wt. 15 Lbs.

3 Heathkit **TV PICTURE TUBE TEST ADAPTER**

The Heathkit TV picture tube test adapter is designed for use with the Model TC-2 Tube Checker. Test picture tubes for emission, shorts, and thereby determine tube quality. Consists of 12-pin TV tube socket, 4 ft. cable, octal connector, and necessary technical data. (Not a kit.)

MODEL 355
$4.50
Shpg. Wt. 1 Lb.



4 Heathkit . . .

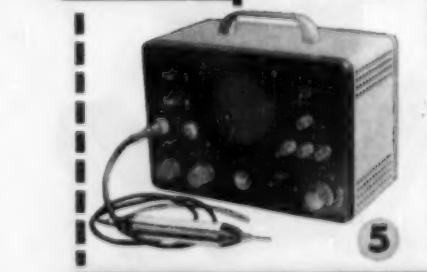
CONDENSER CHECKER KIT

Use this Condenser Checker to quickly and accurately measure those unknown condenser and resistor values. All readings taken directly from the calibrated panel scales without any involved calculation. Capacity measurements in four ranges from .00001 to 1000 mfds. Checks paper, mica, ceramic and electrolytic condensers. A power factor control is available for accurate indication of electrolytic condenser efficiency. Leakage test switch—selection of five polarizing voltages, 25 volts to 450 volts DC to indicate condenser operating quality under actual load conditions. Spring-return test switch automatically discharges condenser under test and eliminates shock hazard to the operator.

Resistance measurements can be made in the range from 100 ohms to 5 megohms. Here again, all values are read directly on the calibrated scales. Increased sensitivity coupled with an electron beam null indicator increases overall instrument usefulness.

For safety of operation, the circuit is entirely transformer operated. An outstanding low kit price for this surprisingly accurate instrument.

MODEL C-3
$19.50
Shpg. Wt. 7 Lbs.



5 Heathkit VISUAL-AURAL

SIGNAL TRACER KIT

This signal tracer is extremely valuable in servicing AM, FM, and TV receivers, especially when it comes to isolating trouble to a particular stage of the circuit under test.

This visual-aural tracer features a high gain RF input channel to permit signal tracing from the receiver antenna input clear through all RF, IF, detector, and audio stages to the speaker. Separate low-gain channel provided for audio circuit exploration. Both visual and aural indication by means of a speaker or headphone, and electron beam "eye" tube as a level indicator. Also incorporates a noise locater circuit for DC noise checks, and a built-in calibrated wattmeter (30-500 watts). Panel terminals provided for "patching" output transformer or speaker into external circuit for test purposes. Designed especially for the radio and TV serviceman. Cabinet size: 9½" wide x 6½" high x 5" deep. A real test equipment bargain.

MODEL T-3
$23.50
Shpg. Wt. 9 Lbs.

HEATH COMPANY

A SUBSIDIARY OF DAYSTROM INC

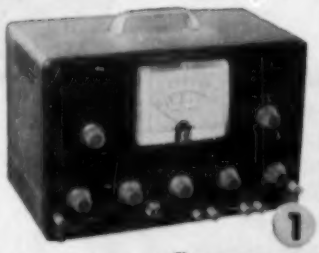
BENTON HARBOR 15, MICHIGAN

MODEL HD-1

Shpg. Wt. 13 Lbs. **$49.50**

Used with a sine wave generator, the Model HD-1 will check the harmonic distortion output of audio amplifiers under a variety of conditions. Reads distortion directly on the meter as a percentage of the input signal. Operates between 20 and 20,000 cps. High impedance VTVM circuit for initial reference settings and final distortion readings. Ranges are 0-1, 3, 10, and 30 volts full scale. 1% precision resistors. Distortion scales are 0-1, 3, 10, 30 and 100% full scale. Requires only .3 volt input for distortion test.

Heathkit HARMONIC DISTORTION METER KIT



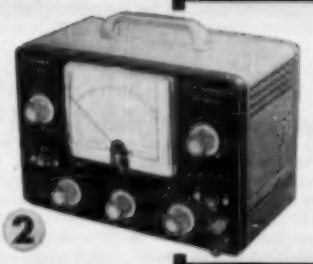
1

1 Heathkit AUDIO ANALYZER KIT

This instrument consists of an audio wattmeter, an AC VTVM, and a complete IM analyzer, all in one compact unit.

Use the VTVM to measure noise, frequency response, output gain, power supply ripple, etc. Use the wattmeter for measurement of power output. Internal loads provided for 4, 8, 16, or 600 ohms. VTVM also calibrated for DBM units. High or low impedance IM measurements made with built-in 6KC and 60 cps generators. VTVM ranges are .01, to 300 volts in 10 steps. Wattmeter ranges are .15 mw. to 150 w. in 7 steps. IM scales are 1% to 100% in 5 steps.

MODEL AA-1 **$59.50** Shpg. Wt. 13 Lbs.



2

2 Heathkit AUDIO GENERATOR KIT

This new Heathkit Model features step-tuning from 10 cps to 100 Kc with three rotary switches that provide two significant figures and multiplier. Less than .1% distortion. Frequency accurate to within ± 5%.

Output monitored on a large 4½" meter that reads voltage or db. Both variable and step-type attenuation provided. Meter reads zero-to-maximum at each attenuator position. Output ranges (and therefore meter ranges) are 0-.003, .01, .03, .1, .2, 1, 3, 10 volts. Step-tuning provides rapid positive selection of the desired frequency, and allows accurate return to any given frequency.

MODEL AG-9 **$34.50** Shpg. Wt. 8 Lbs.

3

4

3 Heathkit AUDIO OSCILLATOR KIT

(SINE WAVE — SQUARE WAVE)

The Model AO-1 features sine wave or square wave coverage from 20-20,000 cps in 3 ranges. It is an instrument specifically designed to completely fulfill the needs of the serviceman and high fidelity enthusiast. Offers high level output across the entire frequency range, low distortion and low impedance output. Features a thermistor in the second amplifier stage to maintain essentially flat output through the entire frequency range. Produces an excellent sine wave for audio testing, or will produce good, clean, square waves with a rise time of only 2 microseconds.

MODEL AO-1 **$24.50** Shpg. Wt. 10 Lbs.

4 Heathkit RESISTANCE SUBSTITUTION BOX KIT...

Provides switch selection of 36 RTMA 1 watt standard 1% resistors ranging from 15 ohms to 10 megohms. Numerous applications in radio and TV work, and essential in the developmental laboratory.

MODEL RS-1 **$5.50** Shpg. Wt. 2 Lbs.

5

6

5 Heathkit AC VACUUM TUBE VOLTMETER KIT...

The Heathkit AC VTVM features high impedance, wide frequency range, very high sensitivity, and extremely wide voltage range. Will accurately measure a voltage as small as 1 mv. at high impedance. Excellent for sensitive AC measurements required by laboratories, audio enthusiasts and experimenters. Frequency response is substantially flat from 10 cps to 50 Kc. Ranges are .01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 v. RMS. Total db range −52 to + 52 db. Input impedance 1 megohm at 1 Kc.

MODEL AV-2 **$29.50** Shpg. Wt. 5 Lbs.

6 Heathkit CONDENSER SUBSTITUTION BOX KIT...

Very popular companion to Heathkit RS-1. Individual selection of 18 RTMA standard condenser values from .0001 mfd to .22 mfd. Includes 18" flexible leads with alligator clips.

MODEL CS-1 **$5.50** Shpg. Wt. 2 Lbs.

HEATH COMPANY

A SUBSIDIARY OF DAYSTROM INC.

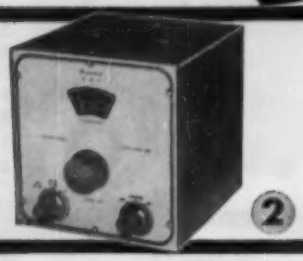
BENTON HARBOR 15, MICHIGAN

HEATHKIT HAM GEAR

for high quality at moderate cost

MODEL DX-100

DOLLAR VALUE: *You get more for your Heathkit dollar because your labor is used to build the kit instead of paying for someone else's. Also, the middleman's margin of profit is eliminated when you deal directly with the manufacturer.*



1 *Heathkit* DX-100 PHONE & CW TRANSMITTER KIT

The reception given this amateur transmitter has been tremendous. Reports from radio amateurs using the DX-100 are enthusiastic in praising its performance and the high quality of the components used in its assembly. Actual "on the air" results reflect the careful design that went into its development.

The DX-100 features a built-in VFO, modulator, and power supplies, and is completely bandswitching for phone or CW operation on 160, 80, 40, 20, 15, 11, and 10 meters. All parts necessary for construction are supplied in the kit, including tubes, cabinet, and detailed step-by-step instructions. Easy to build, and a genuine pleasure to operate.

Employs push-pull 1625's modulating parallel 6146's for RF output in excess of 100 watts on phone and 120 watts on CW. May be excited from the built-in VFO or from crystals (crystals not included with kit). Features five-point TVI suppression: (1) pi network interstage coupling to reduce harmonic transfer to the final stage; (2) pi network output coupling; (3) extensive shielding; (4) all incoming and outgoing circuits filtered; (5) inter-locking cabinet seams to eliminate radiation except through the coaxial output connector. Pi network output coupling will match 50 to 600 ohm non-reactive load. Illuminated VFO dial and meter face. Remote control socket provided.

The chassis is made of extra-strong 11G gauge copper-plated steel. It employs potted transformers, ceramic switch and variable capacitor insulation, solid silver loading switch terminals, and high-grade well-rated components throughout. Features a pre-formed wiring harness, and all coils are pre-wound.

High-gain speech amplifier for dynamic or crystal microphones, and restricted speech range for increased intelligence. Plenty of audio power reserve. Measures 20⅛" W. x 13¾" H. x 16" D. Schematic diagram and complete technical specifications on request.

MODEL DX-100
$189.50
Shpg. Wt. 120 Lbs.

Shipped Motor Freight Unless Otherwise Specified
$50.00 Deposit Required on C.O.D. Orders

2 *Heathkit* VFO KIT

The Model VF-1 covers 160-80-40-20-15-11 and 10 meters with three basic oscillator frequencies. Better than 10-volt average RF output on fundamentals. Features illuminated and pre-calibrated dial scale. Cable and plug provided to fit crystal socket of any modern transmitter.

Enjoy the convenience and flexibility of VFO operation at no more than the price of crystals. May be powered from plug on the Heathkit Model AT-1 transmitter, or supplied with power from most transmitters. Measures: 7" H. x 6½" W. x 7" D.

MODEL VF-1
$19.50
Shpg. Wt. 7 Lbs.

3 *Heathkit* CW AMATEUR TRANSMITTER KIT

The Model AT-1 is an ideal novice transmitter, and may be used to excite a higher power rig later on.

This CW transmitter is complete with its own power supply, and covers 80, 40, 20, 15, 11, and 10 meters. Features single-knob bandswitching, and panel meter indicates grid or plate current for the final amplifier. Designed for crystal operation or external VFO. Crystal not included in kit. Incorporates such features as key click filter, line filter, copper-plated chassis, pre-wound coils, 52 ohm coaxial output, and high quality components throughout. Instruction book simplifies assembly. Employs a 6AG7 oscillator, 6L6 final amplifier. Operates up to 35 watts plate power input.

MODEL AT-1
$29.50
Shpg. Wt. 15 Lbs.

4 *Heathkit* . . . ANTENNA COUPLER KIT

The Model AC-1 will properly match your low power transmitter to an end-fed long wire antenna. Also attenuates signals above 36 Mc, reducing TVI. 52 ohm coax. input—power up to 75 watts—10 through 80 meters—tapped inductor and variable condenser—neon RF indicator—copper plated chassis and high quality components. Ideal for use with Heathkit AT-1 Transmitter.

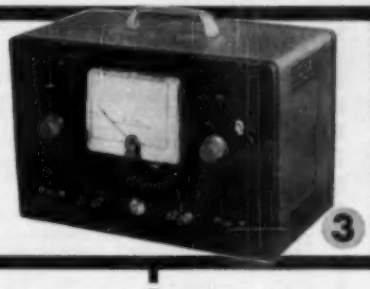
MODEL AC-1
$14.50
Shpg. Wt. 4 Lbs.

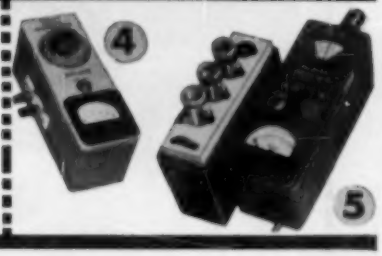
HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 15, MICHIGAN**

"AMATEUR-ENGINEERED"

Equipment For The Ham

MODERN DESIGN: *You can be sure of getting all the latest and most desirable design features when you buy Heathkits. Advanced-design is a minimum standard for new Heathkit models.*





1 *Heathkit* COMMUNICATIONS-TYPE ALL BAND RECEIVER KIT

The new Model AR-3 features improved IF and RF performance, along with better image rejection on all bands. Completely new chassis layout for easier assembly, even for the beginner

Covers 550 Kc to 30 Mc in four bands. Provides sharp tuning and good sensitivity over the entire range. Features a transformer-type power supply—electrical bandspread—separate RF and AF gain controls—antenna trimmer—noise limiter—AGC—BFO—headphone jacks—5½" PM speaker and illuminated tuning dial.

CABINET: Fabric covered cabinet with aluminum panel as shown. Part No. 91-shipping weight 5 lbs. $4.50.

MODEL AR-3
$27.95*
Shpg. Wt. 12 Lbs.
(Less Cabinet)

2 *Heathkit* "Q" MULTIPLIER KIT

Here is the Heathkit Q Multiplier you hams have been asking for. A tremendous help on the phone and CW bands when the QRM is heavy. Provides an effective Q of approximately 4,000 for extremely sharp "peak" or "null." Use it to "peak" the desired signal or to "null" an undesired signal, or heterodyne. Tunes to any signal within the IF band-pass of your receiver. Also provides "broad peak" for conditions where extreme selectivity is not required.

Operates with any receiver having an IF frequency between 450 and 460 Kc. Will not function with AC-DC type receivers. Requires 6.3 volts AC at 300 ma. and 150 to 250 VDC at 2 ma. Derives operating power from your receiver. Uses a 12AX7 tube, and special High-Q shielded coils. Simple to connect with the cable and plugs supplied. Measures only 4-11/16"H.x7⅜"W.x4½"D. A really valuable addition to the receiving equipment in your ham shack.

MODEL QF-1
$9.95*
Shpg. Wt. 3 Lbs.

3 *Heathkit* VARIABLE VOLTAGE REGULATED POWER SUPPY KIT

Provides well filtered DC output, variable from zero to 500 volts at no load and *regulated* for stability. Will supply up to 10 ma. at 450 VDC, and up to 130 ma. at 200 VDC. Voltage or current monitored on front panel meter. Also provides 6.3 VAC at 4A. for filament. Filament voltage isolated from B+, and both isolated from ground. Invaluable around the ham shack for supplying operating potentials to experimental circuits. Use in all types of research and development laboratories as a temporary power supply, and to determine design requirements for ultimate power supply.

MODEL PS-3
$35.50*
Shpg. Wt. 17 lbs.

4 *Heathkit* ANTENNA IMPEDANCE METER KIT

Use in conjunction with a signal source for measuring antenna impedance, line matching, adjustment of beam and mobile antennas, etc. Will double as a phone monitor or relative field strength indicator. 100 μa. meter employed. Covers the range from 0-600 ohms. An instrument of many uses for the amateur.

MODEL AM-1
$14.50*
Shpg. Wt. 2 lb.

5 *Heathkit* GRID DIP METER KIT

This is an extremely valuable tool for accomplishing literally hundreds of jobs on all types of equipment. Covering from 2 Mc to 250 Mc, the GD-1B is compact and can be operated with one hand. Uses a 500 μa. meter for indication, with a sensitivity control and headphone jack. Includes prewound coils and rack. Indispensable instrument for hams, engineers, or servicemen.

MODEL GD-1B
$19.50*
Shpg. Wt. 4 lbs.

HEATH COMPANY *A Subsidiary of Daystrom, Inc.* BENTON HARBOR 15, MICHIGAN

Heathkits

PROVIDE THE "CONSTRUCTIVE" APPROACH TO

HIGH-FIDELITY

EASY TO BUILD: *The assembly instructions supplied with Heathkits are so complete and detailed that anyone can assemble the kits without difficulty. Plenty of pictorial diagrams and step-by-step instructions. Information on resistor color codes, soldering, use of tools, etc. Build-it-yourself with confidence!*

1

1 Heathkit ADVANCED-DESIGN HIGH FIDELITY AMPLIFIER KIT

The 25 Watt Model W-5 is one of the most outstanding high fidelity amplifiers available today—at any price. Incorporates the very latest design features to achieve true "presence" for the super-critical listener.

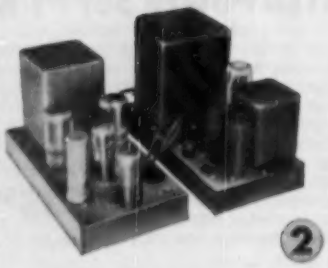
Features a new-design Peerless output transformer, and KT66 output tubes handle power peaks up to 42 watts. The unique "tweeter-saver" suppresses high frequency oscillation. A new type balancing circuit results in closer "dynamic" balance between output tubes. Features improved phase shift characteristics and frequency response, with reduced IM and harmonic distortion. Color styling harmonizes with the Heathkit WA-P2 Preamplifier and the FM-3 Tuner.

Frequency response—within ± 1 db from 5 cps to 160 Kc at 1 watt. Harmonic distortion only 1% at 25 watts, 20-20,000 cps. IM distortion only 1% at 20 watts, using 60 and 3,000 cps. Output impedance 4, 8, or 16 ohms. Hum and noise—99 db below rated output. Uses two 12AU7's, two KT66's and a 5R4GY.

KIT COMBINATIONS:

W-5M Amplifier Kit: Consists of main amplifier and power supply, all on one chassis. Complete with all necessary parts, tubes, and comprehensive manual. Shpg. Wt. 31 lbs. Express only. **$59.75**

W-5 Combination Amplifier Kit: Consists of W-5M Amplifier Kit listed above *plus* Heathkit Model WA-P2 Preamplifier Kit. Complete with all necessary parts, tubes, and construction manuals. Shpg. Wt. 38 lbs. Express only. **$79.50**



2

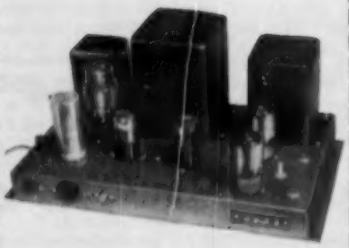
2 Heathkit DUAL-CHASSIS WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

This is a very popular high fidelity amplifier kit that features dual-chassis type construction. The resulting physical dimensions offer an additional margin of flexibility in installation. It features the famous Acrosound TO-300 "ultra-linear" output transformer, and has a frequency response within ± 1 db from 6 cps to 150 Kc at 1 watt. Harmonic distortion only 1% at 21 watts. IM distortion at 20 watts only 1.3% at 60 and 3,000 cps. Rated power output is 20 watts. Output impedance 4, 8, or 16 ohms. Hum and noise—83 db below 20 watts. Uses two 6SN7's, two 5881's, and a 5V4G.

KIT COMBINATIONS:

W-3M: Consists of main amplifier and power supply for separate chassis construction. Includes all tubes and components necessary for assembly. Shpg. Wt. 29 lbs., Express only. **$49.75**

W-3: Consists of W-3M Kit listed above *plus* Heathkit Model WA-P2 Preamplifier described on opposite page. Shpg. Wt. 37 lbs., Express only. **$69.50**



3

3 Heathkit SINGLE-CHASSIS WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

This is the lowest priced Williamson type amplifier ever offered in kit form, and yet it retains all the usual features of the Williamson type circuit. Main amplifier and power supply combined on one chassis, and uses a new-design Chicago output transformer. Frequency response—within ± 1 db from 10 cps to 100 Kc at 1 watt. Harmonic distortion only 1.5% at 20 watts. IM distortion at rated output, 2.7% at 60 and 3,000 cps. Rated power output is 20 watts. Output impedance 4, 8, or 16 ohms. Hum and noise—95 db below 20 watts. Uses two 6SN7's, two 5881's, and one 5V4G.

Instructions are so complete that the kit may be assembled successfully even by a beginner in electronics.

KIT COMBINATIONS:

W-4AM: Consists of main amplifier and power supply for single chassis construction. Includes all tubes and components necessary for assembly. Shpg. Wt. 28 lbs. Express only. **$39.75**

W-4A: Consists of W-4AM Kit listed above *plus* Heathkit Model WA-P2 Preamplifier described on opposite page. Shpg. Wt. 35 lbs. Express only. **$59.50**

HEATH COMPANY

A SUBSIDIARY OF DAYSTROM INC.

BENTON HARBOR 15, MICHIGAN

ATTRACTIVELY STYLED: *Heathkit high fidelity instruments are not only functional, but are most attractive in physical design. Such units as the preamplifier and the W-5 main amplifier are designed for beauty as well as performance. They blend with any room decor and are the kind of instruments you will be proud to own.*

enjoy....
THE VERY BEST IN AUDIO WITH "BUILD-IT-YOURSELF"
HEATHKITS

❶ *Heathkit* HIGH FIDELITY PREAMPLIFIER KIT

This outstanding preamplifier is designed specifically for use with the Heathkit Williamson type amplifiers. It completely fulfills the requirements for remote control, compensation and preamplification, and exceeds even the most rigorous specifications for high fidelity performance.

Features five separate switch-selected input channels (2 low level and 3 high level), each with its own input control. Full record equalization with four-position turnover control and four-position rolloff control.

Output jack for tape recorder – separate bass control with 18 db boost and 12 db cut at 50 cps. – treble control offering 15 db boost and 20 db cut at 15,000 cps – special hum control to insure minimum hum level – and many other desirable features. Overall frequency response (with controls set to "flat" position) is within 1 db from 25 cps to 30,000 cps. Will do justice to the finest available program sources. Beautiful satin-gold finish.

Power requirements from the Heathkit Williamson type high fidelity amplifier – 6.3 VAC at 1 amp., and 300 VDC at 10 Ma. Uses two 12AX7's and one 12AU7.

MODEL WA-P2
$19.75*
Shpg. Wt. 7 Lbs.

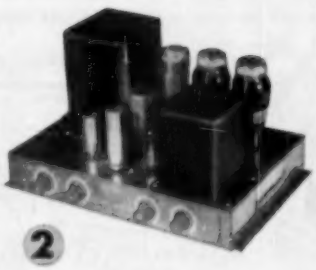
❶

❷ *Heathkit* 20-WATT HIGH FIDELITY AMPLIFIER KIT

This Heathkit Model offers you the least expensive route to high fidelity performance. Frequency response is ± 1 db from 20-20,000 cps. Features full 20 watt output using push-pull 6L6's, and incorporates separate bass and treble tone controls. Preamplifier and main amplifier are built on the same chassis. Four switch-selected compensated inputs and separate bass and treble tone controls provide all necessary functions at minimum investment. Features miniature tube types for low hum and noise.

Uses 12AX7, two 12AU7's, two 6L6G's and a 5V4G. A most interesting "build-it-yourself" project, and an excellent hi-fi amplifier for home use. Well suited, also, for public address applications because of its high power output and high quality audio reproduction. Another Heathkit "best-buy" for you!

MODEL A-9B
$35.50*
Shpg. Wt. 23 Lbs.



❷

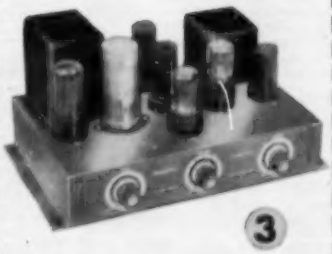
❸ *Heathkit* 7-WATT AMPLIFIER KIT

The redesigned Model A-7D features a new type output transformer for tapped screen operation, and provides improved sensitivity, reduced distortion, and increased power output.

The full 7-watt output of the Model A-7D is more than adequate for normal home installations. Frequency characteristics are ± 1½ db from 20 to 20,000 cps. Potted output and power transformers employed. Push-pull output – detailed construction manual – top quality parts – high quality audio without great expense. Output transformer tapped at 4, 8, and 16 ohms. Bass and treble tone controls provided on the front chassis apron.

MODEL A-7D
$16.95*
Shpg. Wt. 10 Lbs.

Model A-7E: Provides a preamplifier stage with two switch-selected inputs and RIAA compensation for variable reluctance or low level cartridges. Preamplifier built on same chassis as main amplifier. Model A-7E. Shipping weight 10 lbs. $18.50.



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BENTON HARBOR 15, MICHIGAN

MODEL FM-3

Shpg. Wt. 7 lbs. **$24.50** (with cabinet)

Brand New HEATHKIT HIGH-FIDELITY FM TUNER KIT

Features

- *Brand New, Modern FM Circuit Using Latest Type Miniature Tubes.*
- *Low-Noise Cascode RF Stage—Two IF's—Ratio Detector —Stage of Audio.*
- *Extremely Good Sensitivity and Band-Pass for Outstanding Performance.*
- *Strikingly Attractive Satin-Gold Finish to Match Heathkit Model WA-P2 Preamplifier.*
- *Compact Physical Dimensions for Most Pleasing Appearance and Increased Circuit Efficiency.*

The new Heathkit Model FM-3 features tremendous circuit improvements and brand new physical design. Sensitivity is better than 10 μv. for 20 db of quieting, and it employs a completely modern tube line-up for high gain and stable operation. Incorporates its own power supply, and has provision for low-level or high-level output at low impedance.

The attractive Model FM-3 matches the WA-P2 Preamplifier in color, styling, and physical size.

Incorporates automatic gain control, a highly stabilized oscillator, and illuminated tuning dial. Educational treatment of construction manual simplifies assembly for the newcomer to electronics. *IF* and *ratio* transformers are *pre-aligned*, and the front-end tuning unit is pre-assembled and aligned. Uses 6BQ7A as a cascode type RF stage, 6U8 oscillator-mixer, two 6CB6's as IF amplifiers, a 6AL5 ratio detector, a 6C4 audio amplifier, and 6X4 rectifier.

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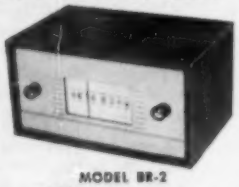

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HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 15, MICHIGAN**

Antenna News

FRINGE ANTENNA

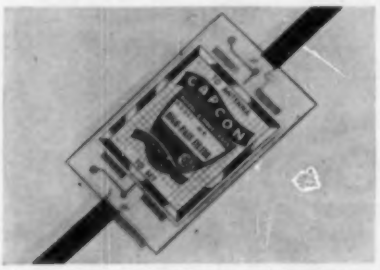
Kay-Townes Antenna Co., Rome, Ga. announces a new inline-type v.h.f. TV antenna for fringe areas. The "Little Jim," as it is called, uses a new type director element which results in high gain and good directivity throughout the v.h.f. band and, at the same time, permits close coupling of the directors without a sharp decrease in radiation resistance. The complete antenna is mounted on a crossarm of only 96 inches.

The "Little Jim" is of aluminum and aluminized construction and incorporates a new snap-lock construction. The antenna is furnished in two models, the LJ-1 and LJ-2.

PC HIGH-PASS FILTER

Capcon, Inc., 25 Willett Street, New York 2, N. Y. is now offering a new printed-circuit, high-pass filter which has been designed to eliminate or suppress TV picture interference from ignition, diathermy, amateur, industrial equipment, neon signs, electrical appliances, and other extraneous signals.

The printed circuit contains six precision coils and four capacitors. The unit will filter out all interfering signals below 54 mc. with an attenuation



above 45 db. The filter can be used on any TV set. Convenient leads are attached for easy installation. The entire unit is completely enclosed in a transparent plastic case.

TELESCOPING MAST

Jones & Laughlin Steel Corporation, 3 Gateway Center, Pittsburgh 30, Pa. has developed a new line of "Perma-Tube" which will permit TV service technicians to assemble a "custom-made" telescoping antenna mast in heights up to 50 feet.

The high strength, corrosion-resistant, electricwelded steel tubing will be shipped to distributors in five different sizes, all in 10 foot lengths. The sections range in size, in quarter-inch gradations, from the largest with an o.d. of 2¼" down to the smallest with an o.d. of 1¼". These sections of "Perma-Tube" have one end expanded and the other end reduced. Slots and

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For service beginners, Radio & Television Receiver TROUBLE-SHOOTING AND REPAIR is a complete, easily understood professional training course. For experienced servicemen, it is the ideal way to "brush up" on specific jobs; to develop better troubleshooting methods and shortcuts; and to find quick answers to puzzling service problems.

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Radio & Television Receiver CIRCUITRY AND OPERATION gives you a complete understanding of basic circuits as well as their variations. It teaches you to recognize them . . . to understand their peculiarities . . . to know their likely "troublespots" . . . and how to eliminate guesswork and useless testing.

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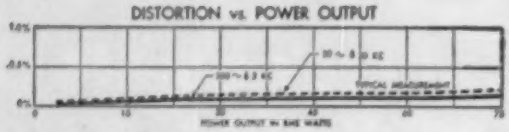

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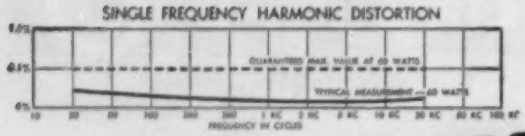

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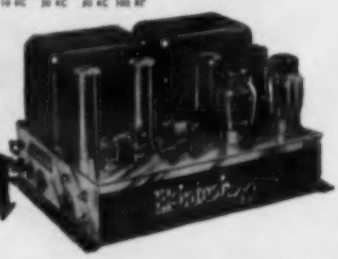

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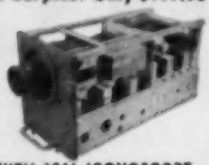

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FM WAVE TRAP

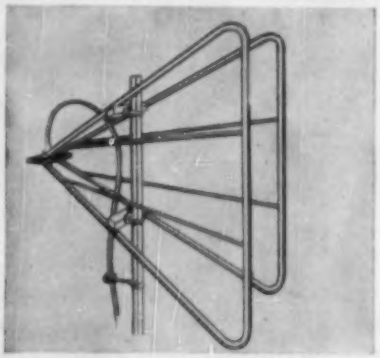
Blonder-Tongue Laboratories, Inc., 526 North Avenue, Westfield, N. J. is now supplying a precision tunable trap to eliminate FM interference in master TV systems and individual TV sets. Any FM broadcast frequency from 88 to 108 mc. may be attenuated more than 20 db with the use of this trap. Rejection ranges from 35 db at the center of the interference signal to less than 3 db 1.5 mc. on either side.

The unit's feedthrough circuit is designed to insure 75 ohm impedance match on all v.h.f. TV channels. Standard u.h.f. cable connectors are used. The trap, called the Model MWT-1, is weather protected and may be mounted on the antenna mast, at master amplifier inputs, or at TV set terminals.

U.H.F.-V.H.F. ANTENNA

Television Hardware Mfg. Co., a division of *General Cement Mfg. Co.*, 400 South Wyman Street, Rockford, Ill., has developed a new u.h.f.-v.h.f. corner horn type antenna which is claimed to have unusually high gain. It is called the "Telco Sky-Wing" and is of all-aluminum construction.

The "Telco Sky-Wing" comes assembled, ready for immediate installation, and is available through parts distributors. Additional information



and price data may be obtained by writing to the manufacturer and referring to Catalogue No. A-300.

MULTI-SET COUPLER

Technical Appliance Corporation, Sherburne, New York has developed a multi-set coupler for private homes, apartments, motels, or other outdoor installations.

These new *Taco* Model 825 couplers are available as two-way or three-way splitting devices. Housed in weatherproof cases, the couplers are designed for installation on the exterior of the building, reducing long indoor runs of transmission line. These units are of the voltage-splitting type and do not require power line connections. In high signal strength areas, the units may be used in tandem to provide a trouble-free television signal distribution system. *Taco* recommends the use of a broadband, high-gain antenna with this signal-splitting device. —30—

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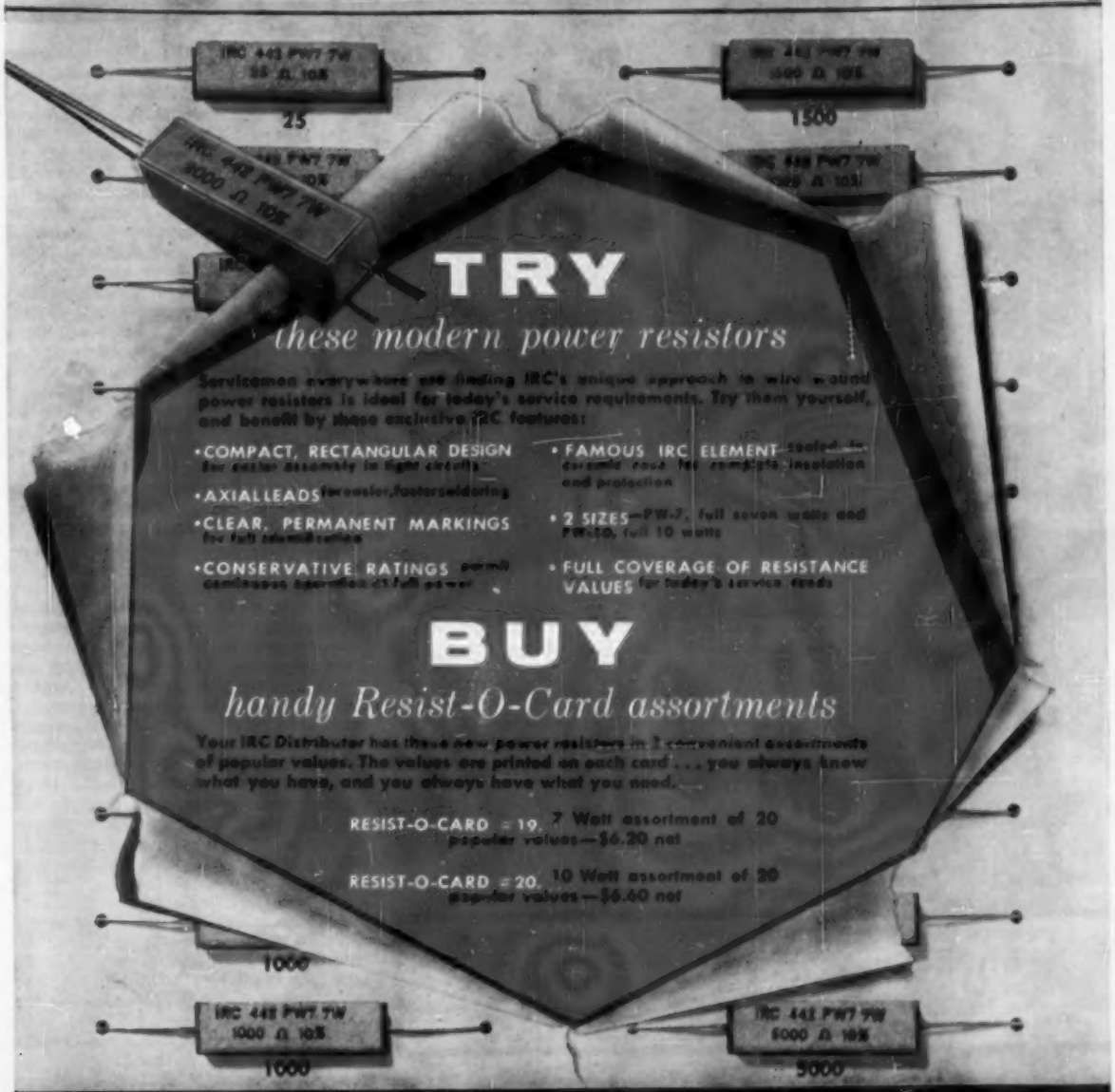

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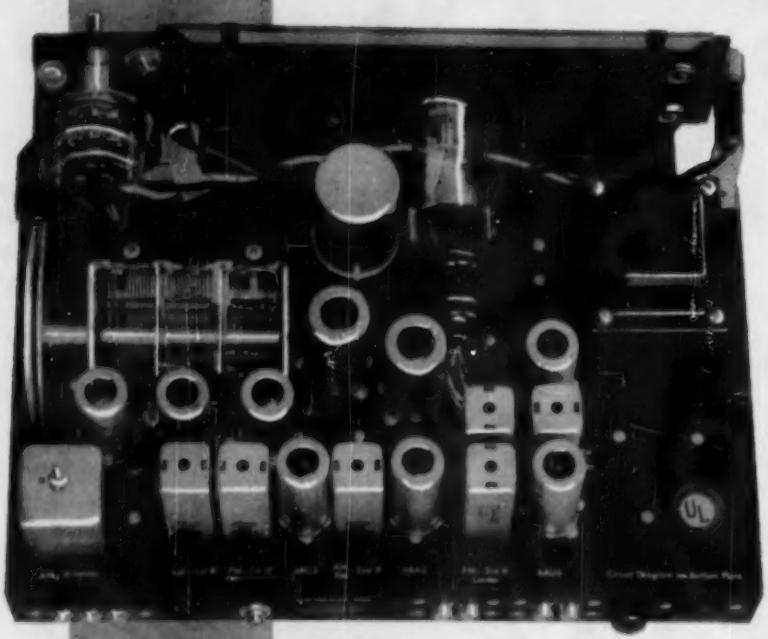
the "200" AM-FM



Top chassis view of the "Compact 200" AM-FM tuner unit.

By **DONALD WARNER**
Chief Eng., Newcomb Audio Products Co.

Performance details and circuit data on a new AM-FM tuner which has been designed for operating simplicity.

THE days of the "bare chassis" tuner are just about over. With hi-fi rapidly leaving the hobbyist's cluttered workshop and moving into the music lover's living room, the modern tuner must not only operate simply and efficiently on both the AM and FM bands, but it must look as if it belonged in its new surroundings. It must also be capable of being mounted behind a cabinet panel without using a hacksaw on the control shafts or knobs.

The new *Newcomb* "Compact 200" tuner meets these requirements nicely. It has been styled to fit into any decorative scheme. It is housed in a finished cabinet which matches the firm's line of audio amplifiers.

Both the tuner and its associated amplifier can be easily installed behind a cabinet panel by utilizing the firm's "Adjusta Panel" feature. By simply loosening four screws on the underside of the set, the whole chassis slides forward through the front of its enclosure for maximum ease of installation.

Like the modern automobile, a tuner must have more than beauty. It must have adequate performance—performance beyond that needed for average local reception. However, again reflecting the changing hi-fi picture (from the home lab to the living room), a modern tuner must be easy to operate. Such features as adjustable sensitivity controls, variable a.f.c. controls, duplicate volume controls, tricky a.f.c. defeats, and squelch controls are not for Milady who, in this new scheme of things, will do as much listening to FM in the daytime as Pop does at night.

On the technical side, the FM section has a quieting sensitivity of better than 30 db for an input of 2 μv. Production sets have been averaging 35 db quieting at 90 mc., 33 at 100 mc., and 32 at 106 mc. at 2 μv. input, using the standard IRE test setup. Even with this sensitivity, the set is not overly complicated as indicated by the schematic, nor is it in any sense narrow band. The i.f. bandpass is 200 kc. wide while the detector circuit approaches ⅛ mc.

Adequate automatic gain control applied to both the r.f. and first i.f. amplifiers reduces any tendency of these stages to overload on strong local signals. The use of a.g.c. assists the limiter section to present a uniform signal to the detector. It also eliminates the need for any form of manual sensitivity control.

FM DEVIATION	OUTPUT VOLTAGE	% DISTORTION
22.5 kc.	.413	.43
75 kc.	1.45	.95

FM Generator Distortion = .4%

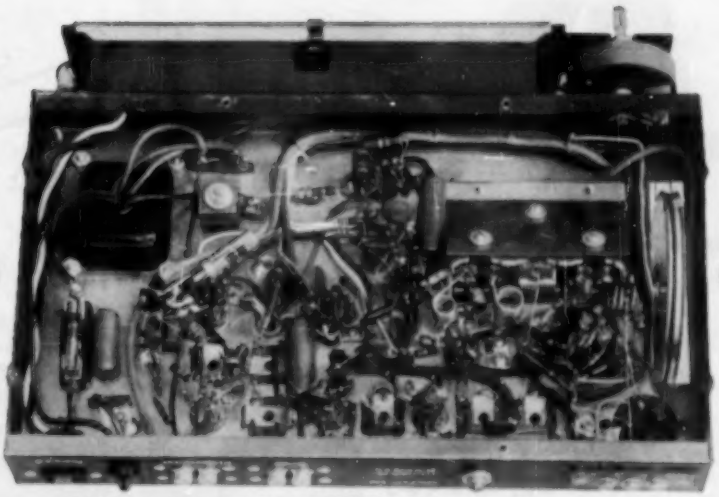
Table 1. Audio output voltage and distortion of the detector system.

OUTPUT VOLTS	DISTORTION
1.25	.15%
2.5	.15%
5.0	.19%
7.5	.27%
10.0	.47%

Generator Distortion = .1%

Table 2. Distortion measurements at various output signal levels.

Tuner



Under chassis view of tuner. Wiring is point-to-point throughout construction.

A 6BC5 sharp cut-off pentode, because of its high input resistance at 100 mc., and with its input circuit arranged for maximum selectivity, was chosen for the r.f. stage. Unless the input circuit is very selective, a strong "off-tune" signal can overload the r.f. tube and cause serious spurious responses. As a further precaution, the screen grid of the r.f. tube was fed through a large dropping resistor, again to increase the ability of the stage to accept, without distortion, large input signals. This factor was considered in the original design.

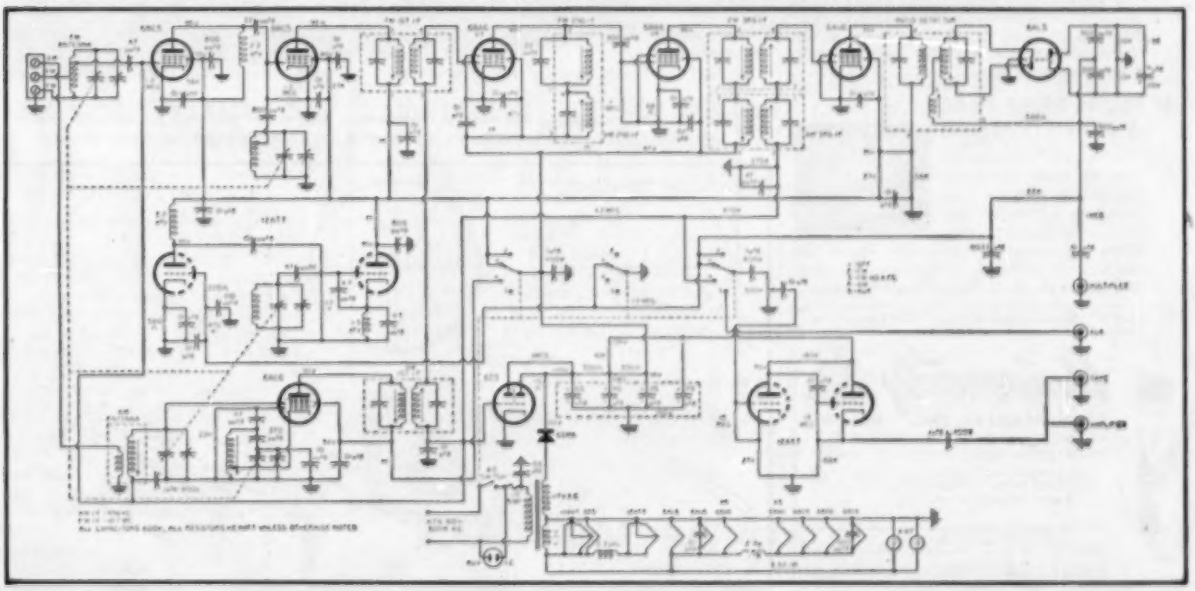
The antenna input was designed to match the 300-ohm folded dipole furnished with the set. However, the design is such that the input circuit will also accept a 72-ohm antenna with negligible mismatch. As a further precaution against spurious responses, the mixer stage also uses a sharp cut-off pentode with circuitry similar to the r.f. stage. It is loosely coupled to the modified Colpitts oscillator to minimize the pulling effect that is so annoying when trying to align the oscillator and mixer on most FM sets. Because many people do not bother to tune in stations as carefully as they should, a.f.c. was included in the design with a defeat position on the selector switch. The temperature-controlled oscillator design and a.f.c. combine to produce extremely drift-free performance and easy operation for novice operators.

The i.f. stages because they have to accept higher signal levels, especially on AM, use remote cut-off pentodes which, while they are not suitable for use in the r.f. stage because of their low input resistance at 100 mc., are very good at 10 mc. or less. The first stage, as noted, is controlled by a.g.c. to prevent any detuning due to overloading. The second stage is cathode-biased for all normal signals. A strong signal can drive the grid negative and produce plate-current limiting. This helps maintain a constant signal to the ratio detector. Ordinarily a ratio detector does not have the benefit of a limiter stage. It is usually preceded by detector driver stage seldom even capable of partial limiting. A ratio detector, besides being a good FM demodulator, is inherently an efficient limiter for low-level signals. This is why a ratio detector is quieter between stations than one using a standard discriminator. The ratio detector only becomes non-linear when it has to accept high signal levels. With proper limiting assistance, the ratio detector can be more desirable than a discriminator. In the *Newcomb* "Compact 200," we have utilized both plate voltage and current limiting. Consequently, due to the triple limiting action (ratio detector's normal limiting action, the limiter stage, and the 2nd i.f. stage) the ratio detector, as used in the "Compact 200," does not have to worry about signal levels it can't properly handle without distortion.

The audio output voltage and the distortion of the detector system are

(*Continued on page* 128)

Complete schematic diagram of the "Compact 200" tuner. Note the simplicity of the circuit design. See discussion in text on circuitry.



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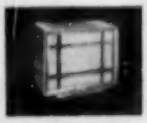

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The "Wizard" Antenna

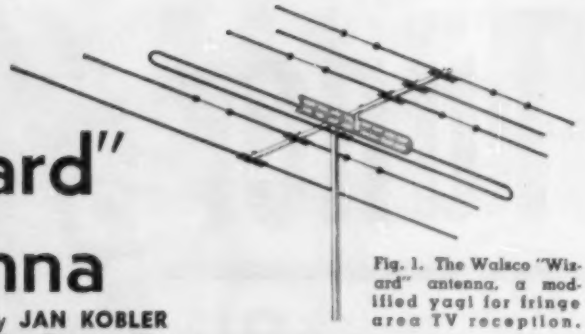


Fig. 1. The Walsco "Wizard" antenna, a modified yagi for fringe area TV reception.

By **JAN KOBLER**
Walsco Electronics Corp.

Fig. 2. A close-up look at the phasing element used in the "Wizard" TV antenna.

An interesting new phasing element is used in this Walsco TV antenna for broadband v.h.f. reception.

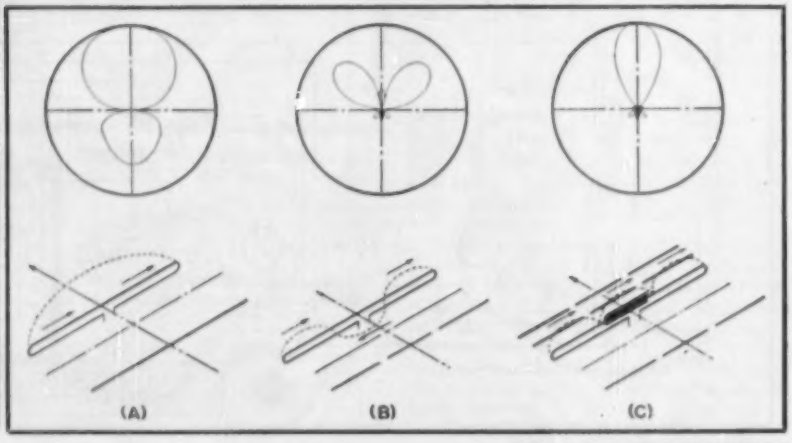
SHOWN in Figure 1 is a new, all-channel v.h.f. antenna, employing a new parasitic phase reversing principle. This antenna is designed to eliminate side lobes and provide a narrow, sharply directional pickup beam that insures dependable reception of signals from the desired direction; at the same time, the high front-to-back ratio of this antenna is effective against co-channel interference (generally characterized by the venetian-blind effect).

The principle of operation of the "Wizard", as this antenna is called, may be easily understood by referring to Fig. 3. The current distribution curve of a half-wave dipole with a reflector is shown in Fig. 3A with its polar diagram.

Note that there is only one direction of antenna current distribution, and that each half of the dipole is ¼ wavelength at the resonant frequency, which for channels 2 to 6 represents the center of the range 54-88 mc. or approximately 66 mc. The antenna's sensitivity pattern is somewhat balloon-shaped. A yagi sharpens the pattern to the shape of the polar diagram of Fig. 3C.

In Fig. 3B may be seen what the current distribution of the dipole and reflector antenna of Fig. 3A would be at a frequency for which its length was 3/2 wavelengths (as would be the case for a 66 mc. dipole on the high TV band, the center of which is approximately 200 mc.). Note that the middle half wave of the antenna exhibits a current direction opposite in phase

Fig. 3. Comparison of the current distribution and polar patterns for an ordinary half-wave dipole with reflector vs dipole with the new "Wizard" phasing element.



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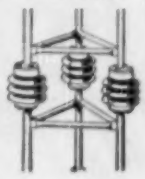

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from the outer half-wave portions. The polar diagram of Fig. 3B has two strong lobes at about 43 degrees and a small one in the forward direction. This is not too satisfactory for television reception.

The reversal of the current direction for the central half-wave section of the 3/2-wave antenna has been accomplished in the "Wizard" with the parasitic phasing element shown in Fig. 2. As is well known, an induced current is opposite in phase from the inducing current. The phasing element shown here first shields the center portion of the dipole from direct signal pickup and then re-radiates the induced current in phase with that of the outer half-wave sections of the 3/2-wave antenna to provide the polar antenna pattern shown in Fig. 3C.

In both Figs. 1 and 3 it is to be noted that the reflector is shown in 3 sections. Two reflector and director assemblies are a part of each "Wizard" antenna. One set of reflector and director elements is dimensioned for ½-wave operation for the low channels 2 to 6 while the other set of reflector and director elements is arranged as illustrated for operation on channels 7 to 13. Each of the three sections of the divided reflector or director elements shown in Fig. 1 is designed for half-wave operation at a frequency within the high band. —30—

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A remarkable value in a kit which permits visual and aural signal tracing of RF, IF, video and audio circuits—costs no more than an audio signal tracer alone. Traces the signal from the antenna to the speaker. Reproduces signal at plate or grid connection of any stage. Identifies and isolates "dead" stages. Features: high usable gain of 50,000; "magic eye" with calibrated attenuators for signal presence indication and stage-by-stage gain measurements; built-in 4" PM speaker; RF probe for checking all stages; special audio probe tip included; provides noise test; built-in watt meter calibrated from 25 to 1000 watts; provision for external scope or VTVM. Complete kit with portable case. Shpg. wt., 13 lbs.

Model F-135 $23.75

Model F-135. Knight Visual-Aural Signal Tracer Kit. Net only $23.75

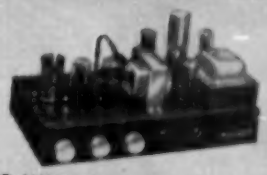
Model F-137 $31.50

KNIGHT AUDIO GENERATOR KIT

Save money—have performance equal to instruments at many times the price! Provides an ideal audio frequency source for checking audio circuits of amplifiers and other hi-fi equipment; also checks speaker response. Frequency range: 20 cps to 1 mc in 5 ranges. Output voltage: 10 volts to high imp., ± 1 db to 200 kc. Generator imp., 600 ohms. Less than .25% distortion from 100 cps through the audible range; less than .5% when driving 600 ohm load at maximum output. Continuously variable step-attenuated output. Circuit as developed by U. S. Bureau of Standards. Complete kit with professional portable case, ready to assemble. Shpg. wt., 17 lbs.

Model F-137. Knight Audio Generator Kit. Net . $31.50

KNIGHT AMPLIFIER KITS FOR HI-FI BUILDERS



10-WATT HI-FI AMPLIFIER KIT

Model S-234 $20.95

Famous for wide response and smooth reproduction at low cost. Only 0.5 volt drives amplifier to full output. Frequency response: ± 1 db, 30-20,000 cps at 10 watts. Harmonic distortion less than 0.5% at 10 watts. Intermod. distortion less than 1.5% at full output. Controls: on-off-volume, bass, treble. Input for crystal phono or tuner. Chassis punched to accommodate preamp kit. Matches 8 ohm speakers. Shpg. wt., 14 lbs.

Model S-234. Amplifier Kit. Net . $20.95

Model S-235. Preamp Kit for above. Net $2.75

20-WATT HI-FI AMPLIFIER KIT

Model S-750 $34.75

True hi-fi for less! Frequency response, ± 1 db, 20 to 20,000 cps at 20 watts. Distortion, 1% at 20 watts. Hum and noise level: tuner input, 90 db below 20 watts; phono, 72 db below 20 watts. Sensitivity: tuner input, 0.6 volt for 20 watts output; magnetic phono, .007 volts. 4 inputs: magnetic phono, microphone, crystal phono or recorder, and tuner. Controls: Bass, Treble, Volume, Selector. With compensation positions for 78 and LP records, controlled from front panel. Shpg. wt., 23 lbs.

Model S-750. 20-Watt Hi-Fi Amplifier. Net $34.75

HOBBYIST SPECIAL!

Model S-243 $13.95

KNIGHT "SPACE SPANNER" RECEIVER KIT

All-new 2-band receiver in easy-to-build kit form at a very low price. Pulls in thrilling short-wave (6 to 17 mc), including foreign broadcast, amateurs, aircraft, police and marine radio, as well as standard broadcast. Bandswitch selects broadcast or short-wave—no plug-in coils. Features: 4" PM speaker and beam power output for plenty of volume; headphone connections; bandspread for easy short-wave tuning; highly sensitive regenerative circuit. Tubes are 12AT7 regenerative detector and audio amplifier, 50C5 output; 35W4 rectifier. Includes all parts and tubes; less only wire and solder. For AC or DC operation. Shpg. wt., 4½ lbs.

83 S 243. Knight "Space Spanner" Kit. Net $13.95

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Allied Radio Corp., Dept. 1-M-5, 100 N. Western Ave., Chicago 80, Ill.

Ship me the following KNIGHT Electronic Kits:

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- Measures just the right length of lead desired.
- Ideal for stripping all insulated wire and cable — as well as non-metallic tubing.

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B-T LABS

Manufacturers of TV Cameras, TV Amplifiers, Boosters, UHF Converters, TV Accessories and Originators of the Masterline and 'Add-A-Unit' Master TV Systems.

An Extended Range Signal Generator

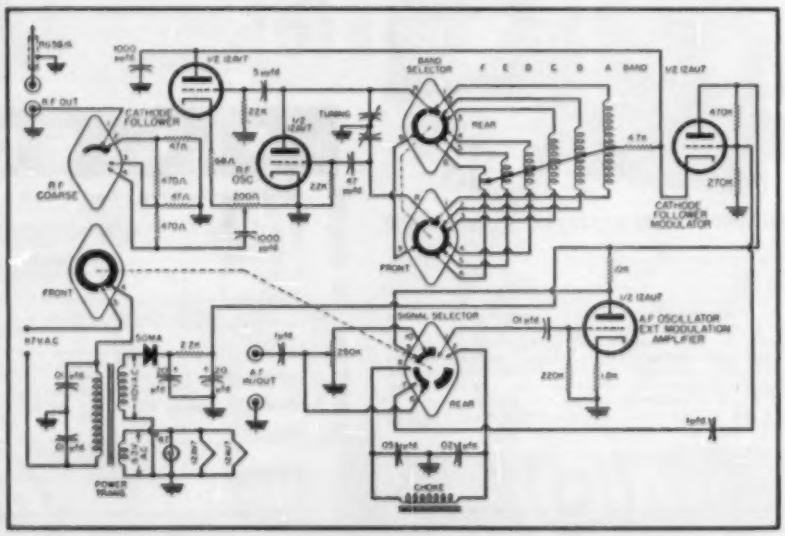
Fig. 1. View of the Eico model 324 sine-wave generator.

This new extended range instrument may be used for troubleshooting all sections of a TV or radio set.

THE r.f. signal generator shown in Fig. 1, manufactured by *Electronic Instrument Co., Inc.*, is capable of furnishing a modulated or unmodulated r.f. sine-wave signal from 175 kc. to 435 mc. As such, it is a good single signal source for radio and television servicing as well as other applications. The actual fundamental frequency range of the instrument is from 150 kc. to 145 mc., on six separate tuning bands. A seventh band, from 111 mc. to 435 mc., is furnished by the third harmonic of the highest fundamental band.

Fig. 2 is the schematic diagram of the model 324 signal generator. As may be noted here, the r.f. oscillator and the audio frequency oscillator, which furnishes a 400-cycle modulating signal, are both Colpitts-type oscillators. The 400-cycle audio signal is available for test purposes by means of front panel connectors. The r.f. oscillator is plate modulated by the 400-cycle signal through a cathode follower. The r.f. output of the instrument is taken from the cathode circuit of a cathode follower. This makes for op-

Fig. 2. Schematic diagram of the Eico model 324 signal generator described in text.



ARROW SALES

46-ACJ UHF (ASB) RECEIVER

13-tube, double conversion receiver. Freq. range: 450-600 MC. Employs 446-A Lighthouse Tubes in RF section, mixer, and oscillator circuits. First IF freq. of 55 MC has 2 stages of amplification; 2nd IF freq. of 16 MC has 4 stages of amp. Two video stages follow 2nd detector. With schematic and these tubes: 8—6AC7, 3—446, 1—6AQ7, 1—6B6. Like new. Wt. 15 lbs. Only..... **$9.95**
LESS 8—6AC7 tubes. Like new. Only..... **$4.95**

BEACON RECEIVER BC-1206-C

Complete with 8 tubes. Tunes 195 KC to 420 KC. IF Frequency—125 KC. Receiver Sensitivity—3 Microvolts for 10 Milliwatts output. Output Impedance—500 Ohms and 4,000 Ohms. Volume Control—RF Gain Control. Power Supply—24-28 Volts Aeroplane Battery. Current—.75 Amperes.
BRAND NEW, with Tubes..... **$9.95**

BC-375 and BC-191 XMITTERS

200 to 500 KC., 1500 to 12500 KC., using plug-in units. 100 Watts, Voice and C.W. Complete with tubes. Less tuning unit. Used, good cond. Your Choice, either type. Each..... **$15.95**

POWER FOR BC-191

GENERATOR GN-39-F—Turn it with a belt from your jacked-up rear wheel, or drive it with a motor or engine. Designed for field power for BC-191, which is 12 V. version of BC-375. Outputs are 1,000 VDC at 350 ma. and 14.6 VDC at 25 A., continuous duty. Two-bearing armature. New..... **$19.95**

MICROPHONE GIVE-AWAYS!

CRYSTAL MIKE CAPSULE—from hearing aids. Sealed in compact, flat container. Crisp, clear, hi-level output. Ideal for tapes, tuckaways, and bugs. Tested and guaranteed. Only..... **99¢ ea.**
MAGNETIC MIKE CAPSULE—MC-255-A. 200 ohms. Works equally well as a receiver unit. New. Only **79¢**
10 for **$6.50**
MANUFACTURERS: WRITE FOR DISCOUNTS ON MC-255-A.

MINIATURIZATION SPECIALS

902 TWO-INCH CATHODE RAY TUBE
First time in surplus! Overall length only 7⅛". Octal base. Electrostatic deflection. Operates on normal B+ voltages. A natural for modulation monitor, TVT-converter indicator, phase angle indicator, etc. New in original carton. **$2.95**
Guaranteed.....

ONE-INCH PANEL METER
0-1 MA. Handsome, black calibration on white face. 1½" square. Mounts through 1⅛" hole. **$3.95**
1% accuracy! Brand new. Only...

VHF TESTER TS-182/UP

SIGNAL GEN. & TEST SET. Complete. For checking power output, receiver sensitivity, pulse shapes and recovery time. Equipment consists of a pulsed R-F oscillator with calibrated frequency dial and attenuator. 115 V., 60-1,800 cps. power. 2AP1 scope tube and 10 other tubes. Freq. range: 180-240 MC. Like New. Wt. 50 lbs..... **$42.50**

ANTENNA MAST

MS-83: Extremely strong steel alloy tube 1½" O.D., 38½" long with threaded brass male and female ends plus 11½" long brass telescoping section to add strength when several are screwed together. Each is electrically 1 meter long. Screw as many together as you like. Sturdy but flexible. Brand new. **$2.98**
Minimum order: 6 for only.....

SOUND POWERED HEAD AND CHEST SETS

No batteries! Communicate over long distances with only 2-conductor wire. Used, dirty, but guaranteed to operate. Each..... **$1.98**; 2 for **$3.50**
SOUND POWERED CAPSULE ONLY! Use for receiver or mike. Excellent condition. **Ea. 49¢; 10 for $3.90**

SPECIAL TELEVISION TRANSMITTER

12 tube, UHF. Used in aircraft. Frequency range: 264-312 MC. Modulates video, sync, and blanking signals and transmits a modulated RF carrier. Has 2 video stages, 2 oscillators, 2 power amplifiers. **$15.75**
Like new, with tubes. Wt. 35 lbs.....

MODEL 27-C TESTER MULTIMETER — $9.95

RANGES: AC and DC volts 0-5/25/250/5,000. DC MA. 0-1/10/100. Ohms 0-100K. Relay 0-100K. Bakelite panel, metal case. Scale over 3" long 1% accuracy! Internal portable battery. New original pack, with battery and test leads. Satisfaction guaranteed.

SPRING COIL CORD

3-conductor mike cable with buzz at both ends. Normal length: 18 in. Expands to over 5 ft. **95¢**
Heavy rubber casing. New! .....
6 for..... **$5.00**

REVERSIBLE GEARED MOTOR

Very powerful! Gear train? The Air Forces didn't try to save us taxpayers any money. The best! 24 V. AC or DC. 7.6 amps at full load. Vary the output speed by reducing voltage. Excellent for winches, garage doors and cattle-gate openers, etc. Has limit travel switches and micro reversing switches which you can modify at will. **$1.95**
Good used. A terrific buy!.....
Ship. wt. 7 lbs. ONLY..... 2 for **$3.90**

TV TUBES! 3 FOR A BUCK!

6AG5 or 6AL5. Removed from new equipment. **MINIATURE SHIELDED TUBE.** 3 for a buck!

3 VDC SYNCHRONOUS VIBRATOR—7-prong. Made by OAK for Motorola 2-way mobile. 1¼" dia., 2⅛" height above socket. New. Only..**89¢**; 10 for **$5.00**

RG-8/U CABLE. 50 ft. Length..... **$4.95**

VERSATILE COAXIAL RELAY

Single pole, double throw. Cuts off its own coil current instantly as it flips to either position and latches. Because contacting current is only used instantaneously, you can flip it with almost any voltage you want from 12VDC to 115 VAC. Contacts will carry 5 amps. Flip it with a remote SPDT switch and 3 wires, or with sequence switching and two wires. Mounted in small alum. box with two SO coax fittings. Can be removed from box if coaxial feature is not desired. New. Only..... **$1.98**; 2 for **$3.90**

OIL FILLED CAPACITORS

8 mfd. 600 VDC.	**$0.98**	15 mfd. 600 VDC, 350 VAC	**$1.49**
10 mfd. 600 VDC.	**1.29**	1 mfd. 1,000 V.	**.99**
12 mfd. 600 VDC.	**1.29**	4 mfd. 2000 V.	**1.98**

CAPACITOR DECADE 1-20 MFD

Four 600 VDC capacitors in one oil-filled hermetically sealed case. By paralleling 1, 2, 4, 5, and 8 mfd. you get from 1 to 20 mfd. in steps of 1 mfd! New, only..... **$1.99**; 2 for only **$3.90**

WATT-HOUR METER

Standard brands, 2-wire in, 2-wire out, 115 Volt, 60 cycle. Used but operating until the day a large power company pulled a thousand out of service all at once because they would rather spend a million than pay income tax. 5 amp ratings are O.K. up to 10 amps. 10 amp ratings are O.K. up to 20 amps.
5 AMPS. ONLY 10 for $9.95..... **$1.29**
10 AMPS. ONLY.. $1.98. 10 for..... **$17.50**

ONE INCH PIPE SIZE SOLENOID VALVE. Corrosion resistant! 18-24 VDC, ½ amp. Brand new. Only..... as **$2.95**

Selenium Rectifier. 20 VAC max. 1.2 A., full wave, will handle 4 of above valves.
New. Only..... **$1.98**

Transformer: 115 V. 60 cy. to 24 V., 1.2 A. for above rectifier & many other uses..... **$1.98**

VERSATILE TRANSFORMER—115V. 60 cy primary. Two identical secondaries, each 200-180-0-180-200 V. @ 100 ma. Series the secondaries for higher voltage or parallel them for higher current. New. Only..... **$2.98**

BENDIX DIRECTION FINDER

MN-26-C. 12-tube remote control Navigational Direction Finder and communications receiver. 150 to 1500 Kc in 3 bands. 28 V. DC input. Ideal for economical operation on boats and planes. Complete installation comprises:
MN-26-C Receiver complete with 12 tubes. **$12.95**
MN-26-P Rotatable Loop..... **$9.95**
MN-54 Antenna Control Equipment..... **9.95**

BUILD AN OSCILLOSCOPE

APN-4 INDICATOR. You get a RCP1, mounted and shielded, with the high-voltage divider network, focusing, intensity, horizontal and vertical positioning controls, and double-deck chassis with octal sockets for up to 27 tubes, plus 22 potentiometers, and countless resistors, capacitors. Light weight, all aluminum, very compact. Only 9 x 12 x 19". Excellent as foundation on which to build your dream scope. Used, good with 90% tube rating. Only..... **$9.95**

LOOK! PE-101-C DYNAMOTOR!

Unused, **externally dirty**, guaranteed electrically. Only..... **$4.95**
12 V. in, 600 V. 180 MA. out.

12 VOLT DYNAMOTORS

BD-281 Long time no see! Here it is. Input 12 V., 10 A. Output 625 V., 325 MA. Good, used, guaranteed. Only..... **$6.95**
BD-44! Brand new with extra set of tube of lubricant! Output 375 V. 150 Ma. with filter base. Late design. Very unusual. Only..... **$4.98**
BY-1/ARR-2X. 12 V. Command Receiver Dynamotor. Plugs on back end of BC or ARC-5 Receivers. Output 250 V. 60 MA. Excellent. Only..... **$4.95**

GENERATOR-ALTERNATOR SPECIAL

120 VAC plus 12 VDC

Plus removable centrifugal slip clutch! Maintains armature at 3,600 RPM for drive speeds of 2400—4200 RPM. Outputs 12 V., 40 A. DC; and 150 W., 800 cy., 1 ph., 1080 VA. New with diagram and instructions..... **$16.95**
CARBON-PILE REGULATOR for above. With instructions..... **$2.95**

LAZY MAN'S Q-5'ER—Navy Type

Made by U.T.C. The best! Chop off QRM by turning knob to pass only 1020 CY, with enough width for code or speech, rejects all else. Or turn knob to pass everything. With phone tip jacks for putting in series between receiver and headsets. 600 ohms. Wt. 3 lbs.
Only..... **$1.95**
2 for only..... **$3.75**

All items **F.O.B.** Otis. Send 25% deposit with C.O.D. orders. All items subject to prior sale and change of price without notice. Sorry, no C.O.D. to APO & FPO.

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★ HI-FI EQUIPMENT! THE GIFT TO GIVE AND GET ★ THIS XMAS!

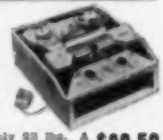
Prepaid! No shipping cost to anywhere in North America or any A.P.O. or F.P.O. address. New 1956 Line! All factory guaranteed.

PENTRON EMPEROR HI-FI COMBINATION TAPE RECORDER, AMPLIFIER & 3-SPEAKER SYSTEM

RECORDER: 2-speed, 2-track. Index counter. Instantaneous braking. Illuminated VU level meter. Single-lever "joystick" control. Interlock button prevents accidental erasure. Fast forward and rewind. 4-pole dynamically balanced motor, flutter less than 0.3%. Response 40-12,000 cps. Hi-fi crystal mike included. 6V6 hi-power bias osc.
AMPLIFIER: 10 W push-pull, 5-tube, balanced for linearity! Use as PA system or play records or radio through it and the speakers, or record from mike, phono, or radio. Tubes: 5879, 6SL7, 12AU7, 2—6AQ5. Power: 6X5GT.
SPEAKERS: Three! With L-C 1,000 cps crossover network. Separate remote tweeter in beautiful cabinet which you can place for binaural effect. Large speakers in main cabinet.
PORTABLE! ALL THIS FOR ONLY..... $187.50

PENTRON PACEMAKER
Brilliantly styled portable recorder with woofer and tweeter. Automatic index counter locates any portion of tape. Unimatic "joystick" control. Instantaneous automatic braking. Straight-line slot-type loading. 2-speed, 2-track. Interlock erase safety. Magic eye level indicator. Fast forward and rewind. Separate record and erase heads. Auxiliary speaker and amplifier jacks. 50-10,500 cps. Motor and flutter specs same as in Emperor. Wt. only 27 lbs. Includes super sensitive crystal mike. Only..... **$139.50**

PENTRON'S BARGAIN!



CLIPPER MODEL: Despite the low price here is a recorder to be proud of! 2-speed, 2-track. Fast forward and rewind! Illuminated level indicator. 4-watt output. 50-9,000 cps. Monomatic single-knob control at the flick of a finger. Includes microphone. Carrying wt. only 23 lbs. A terrific buy at only..... **$99.50**

TUNER & AMPLIFIER

We searched all sources to bring you: Cadillacs at Chevrolet prices! This is it! **PEDERSON.** FM section has tuned RF, low-noise triode mixer, AFC on-off switch for cool tuning, Armstrong dual limiter and discriminator. Completely separate AM & FM sections! AM has low-distortion detector and special RF and IF amplifiers unaffected by signal strength. Both AM and FM are temp. compensated. Heavy lucite dials dramatically edge lit. Tuning mechanism has flywheel shaft and gear-driven capacitor. Special DC filament system, power transformer, and aluminum chassis for extremely low noise and hum better than —90 db. Tuner has magic eye visual indicator. Power amplifier uses unique circuitry and specially designed transformers for clean output you will listen to for hours without "listener's fatigue." Transient response has been considered as important as sinusoidal, and is singularly free of ring or boom.
And you get beauty. Faceplates are permanent gold-anodized with deep etched lettering filled with baked black, set off by black and gold knobs. Units may be used in individual cabinets or combined on a single panel for either vertical or horizontal layout. Optional cabinets are good furniture and available in either blonde or mahogany.
Whether you are a sound technician or an interior decorator, you can't do better at any price!

THE TUNER

Model AFM-2 PARAGON. FM response 0.5 uv from 20-20,000 cy. AM whistle filter over 25 db down at 10 Kc. AM sensitivity 5 uv, FM 3 uv for 30 db quieting. Two controls: flywheel tuning, and selector with choice of OFF, AM, FM-AFC, and FM. 15 tubes, including 6X4 rectifier, and tuning eye. Size: 4 x 14½ x 8 in. deep. Only..... **$119.50**
CABINET: (specify blonde or mahogany)..... **$17.50**

THE AMPLIFIER

Model PCP-20 TRI-AMP. Combines pre-amplifier and control unit with 20 watt power amplifier. Freq. response within ½ db from 15 to 30,000 cps. Williamson circuit with direct-coupled 12AU7 voltage amplifier. First section cathode is fed back with 12 db from 10 ohm output tap thru R-C network to eliminate oscillation. 12AU7 phase inv. drives 5881's push-pull to give interrupted. Distortion below ¼% at 10 W., below 1% at 15 W. Watts. Less than 2% at 20 W. below 1% at 18 W. with reserve peak of 30 W.! Low-noise 12AX7's used for preamp and tone control ampl. Output for 4, 8, and 16 ohm speakers. Inputs from mike with db. response; from var. reluct. phono cartridges with 5 comp. positions (AES, Col. LP, Orthe, and RIAA) and 2 other input positions for tuner, tape, TV or ceramic or xtal. phono. Separate volume and Fletcher-Munson Loudness Control Knobs. Bass control has flat center and 15 db boost or cut at 50 cy. Treble control has flat center and 15 db boost or cut at 10 Kc. Size: 4 x 14½ x 7 in. deep. Less cabinet..... **$99.50**
CABINET (specify blonde or mahogany)..... **$12.50**
COMBINATION SPECIAL! TUNER AND AMPLIFIER ONLY..... **$199.50**
(Less cabinets. Both cabinets combo special..**$27.50**)

HI-FI SPEAKERS

Here again we looked for the best quality at a low price. We came up with Queen Wilhelmina's company in the Netherlands—NORELCO. **Model 97G001.** 12" speaker with response 20-20,000 cy and very mild resonance way down, only 20 cy, as shown on published response curve. Up to 20 W without distortion! 8 ohms impedance. Air gap is twice ordinary depth and flux density is terrific, 8,000 Gauss! Improved cone design with external centering gives extended flat response without harsh stresses. Sealed air gap eliminates booming. Sound diffuser provides uniform spatial distribution of highs with terrific bass reproduction. This one speaker in a good enclosure is all you need! Regular price $54.95.
Your cost only..... **$32.97**
Model 97G20. As good as the above speaker is, Norelco made one a bit better by spending much more money on a still larger magnet (11,000 Gauss) and a dual-cone arrangement for hi-low freq. division. Regular price $99.95. Your cost only..... **$59.97**

CABINET

The R-J Enclosure needs no introduction here. Maximum bass for minimum space. If you buy a 12" speaker you need a good enclosure. This is it!
S-12-U: Kit to fit in bookcase. 24" high x 21" wide x 10" deep. Sanded, unfinished..... **$20.50**
F-12-U: Floor model 20" high x 20" wide x 10" deep. Sanded, unfinished..... **$40.50**
F-12-BS: Floor model finished in mahogany..... **$49.95**
F-12-B: Floor model finished in blonde or ma..**$54.50**

ELECTROSTATIC SYSTEMS

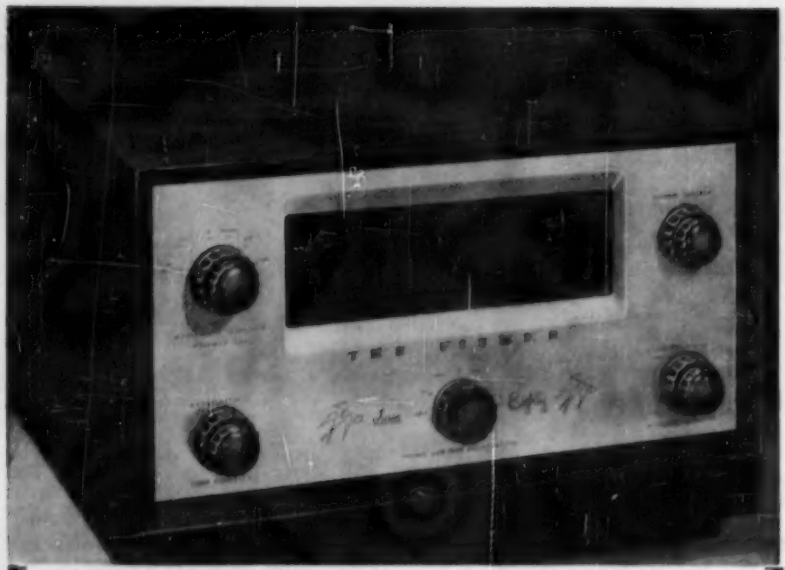
Latest advance in treble reproduction. A revolution in mellow brilliance for restless souls who want to explore new fields!
THE OVERTONE: 2 electrostatic tweeters in V-front cabinet. Connects across any magnetic speaker or system. Response 7-20 Kc. Contains equalizing level control for total balance between highs and lows. Specify blonde or mahogany..... **$47.50**
Same, less cabinet..... **$27.50**
COMPLETE SYSTEM: Symphony. One 12" magnetic and 2 electrostatic tweeters in cabinet with equalizing level control. Nothing else to buy. Dark mahogany or light birch. Modern bowtop design. Only..... **$119.50**

THE RECORD PLAYER

GARRARD RC-80: British import. The best at a good price. 3-speed. **RC-80,** with two plug-in cartridge sheltie..... **$49.50**
GR: Shell only with crystal turnover cartridge, two sapphire needles..... **$6.00**
RC-80-SE: RC-80 with GE variable reluctance RPX-050A, 2 sapphire needles..... **$56.50**
RC-80-GED: Same as above, but with diamond LP and sapphire 78 RPM needles... **$71.50**
BASE: For any RC-80, blonde or mahogany..... **$5.95**

$45.00 HI-FI HEADSET AT $7.95

Uses annular grooved plastic fibre cones with voice coils as in speakers and padded chamois ear muffs to obtain spacing for correct acoustical load. Gives finest music reproduction. 600 ohms. Checked out with freshly laundered ear pads and long flexible fabric cord with phone tips. Each unit individually tested for frequency response. Satisfaction guaranteed! (Ship. wt. 3 lbs.)..... **$7.98**



MODEL 80-T • MOST ADVANCED PROFESSIONAL TUNER WITH COMPLETE AUDIO CONTROL

Hit of the Audio Fairs!

THE SERIES 80

FISHER

FM-AM TUNERS

Here are America's first FM-AM tuners with TWO meters for micro-accurate tuning, just one of the *many* unique features that mark THE FISHER Models 80-T and 80-R as the finest you can buy. They follow deservedly the unmatched reputation of their predecessors, Models 70-RT and 50-R. The 80-T and 80-R are truly designed for the future.

Outstanding Features of THE FISHER Series 80

■ The 80-T features *extreme sensitivity* (1.5 mv for 20 db of quieting.) ■ *Separate* FM and AM front ends, completely shielded and shock-mounted. ■ *Separate* tuning meters for FM and AM ■ 72-ohm, plus *exclusive*, balanced 300-ohm antenna inputs for increased signal-to-noise ratio. ■ AM selectivity adjustable; AM sensitivity better than 1 microvolt. ■ Inherent hum *non-measurable*. ■ Distortion below 0.04% for 1 volt output. ■ 4 inputs, including separate *tape playback* preamp-equalizer. ■ Six record equalization choices. ■ Two cathode follower outputs. ■ 16 tubes. (80-R: 13 tubes.) ■ 9 controls including Bass, Treble, Volume, Function, Equalization, Tuning, Loudness Balance, AFC. ■ Self powered. ■ Magnificent appearance and workmanship. ■ CHASSIS SIZE: 12¼" wide, 8¾" deep less knobs, 6" high (80-R: 4" high.) ■ NOTE: Model 80-R is identical to the above, but is designed for use with an external audio control such as THE FISHER Series 80-C.

MODEL 80-R • FOR USE WITH EXTERNAL AUDIO CONTROL

MODEL 80-T
$199.50

MODEL 80-R
$169.50

MAHOGANY OR BLONDE CABINET: $17.95

Write For FULL Details

FISHER RADIO CORP.
21-23 44th DRIVE
LONG ISLAND CITY 1, N.Y.

timum impedance matching between the generator and the circuit to which it is connected.

Both coarse and fine r.f. attenuation are provided; the coarse attenuator is a step-type switch which includes two 20 db stages of attenuation. The fine attenuator is a 200-ohm continuously variable pot. The 250,000-ohm potentiometer shown in the audio oscillator circuit of Fig. 2 is used to control the output voltage of the audio oscillator when the latter's signal is used for external test purposes. This pot also controls the percentage modulation of the r.f. signal when either the internal or an external modulating signal is used.

A few of the noteworthy mechanical highlights of this instrument, which is available in both kit and wired form, include the use of a copper-plated chassis as well as line filters for minimum interference. The band coils are turret mounted and slug tuned for accuracy. A Plexiglas window with illuminated hairline is also furnished.

The extended-range feature of this instrument permits localization of troubles in the tuner section of TV receivers as well as other uses. Use of the modulated r.f. signal, with the generator set to the picture carrier frequency of any v.h.f. channel, allows checking of the r.f. amplifier, antenna, and downlead. The signal from the generator is fed to the signal grid of the converter tube and if a horizontal bar pattern appears on the picture tube screen, then the previous stages are suspect, if no picture appeared previously.

The *Eico* model 324 signal generator may be bought in kit form for $26.95 or factory wired and tested for $39.95.

—30—

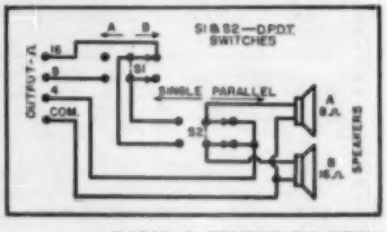
SPEAKER SWITCHING

By HENRY FISCHBACH
Station WKJB, Mayaguez, P.R.

RECENTLY the author was confronted with the problem of connecting two speakers of different impedances (8 and 16 ohms) to the output of a high-fidelity amplifier with the usual 4-8-16 ohm taps. Provision was required for switching in one or the other, or both, speakers together. Lacking any special switches, the problem was solved by using two double-pole, double-throw switches as shown in the diagram.

The only compromise in matching is the use of the 4-ohm tap for the two speakers in parallel. The equivalent impedance is 5⅓ ohms which results in a slight mismatch. —30—

How two d.p.d.t. switches are used to provide flexible switching of two speakers.



Frequency Modulated V.F.O.

(*Continued from page 61*)

oscillator. The optimum setting of this control will vary from band to band and is best determined by on-the-air checks. The final setting will correspond to a deviation of approximately 3 kc. at the operating frequency.

The construction of the unit, while unconventional, is quite simple and straightforward. The chassis is actually a 4⅞ x 4⅞ inch aluminum plate. All the parts, including all the variable controls and tubes, are mounted on this plate. The plate is then mounted parallel to the front panel of a 6 x 6 x 6 inch utility box by means of four one-inch spacers. The tuning and deviation control shafts are then extended through the front panel. This one-inch spacing is enough to allow for the "under chassis" parts as well as the insulated flexible coupling necessary to extend the tuning shaft.

Because of the circuit position of C_3, the rotor must be insulated from the chassis. This is most conveniently done with the capacitor specified by passing two No. 4 screws through the holes in the ceramic front plate of the capacitor and mounting it to the chassis through ¼-inch spacers. The rotor shaft hole in the chassis is drilled with plenty of clearance to insure that it will not touch the chassis. The flexible insulated coupling then extends the shaft to the front panel. In the interests of rigidity and frequency stability another bearing on the front panel is provided for the shaft extending from the flexible coupling through the front panel.

The amplifier tuning coil L_7 is wound on a *National* XR-50 slug-tuned coil form. The 6-32 shaft out of the coil form is extended and adapted to fit a standard ¼ inch knob by partially screwing a ¼ inch threaded spacer about one inch long onto the coil form screw. This is locked in place with a 6-32 lock nut.

After the unit is constructed it is only necessary to align the unit to cover 3.5 to 4.0 mc. in one sweep of the dial. Any one of a number of methods can be employed, depending upon what equipment is available to the constructor. A good calibrated receiver; a frequency meter, such as the BC-221; or even another calibrated v.f.o. can be used for calibrating purposes. Whatever the means, the procedure is identical. Set the v.f.o. to the low-frequency end, *i.e.*, the plates of C_3 completely meshed. Adjust L_7 until the v.f.o. output is 3.5 mc. Now set the v.f.o. to the high-frequency end of the dial, *i.e.*, the plates of C_3 unmeshed. Adjust C_2 until the v.f.o. output is 4.0 mc. It will be necessary to repeat this procedure since the adjustment of C_2 upsets the adjustment of L_7 and *vice versa*. However after repeating this procedure a few times the v.f.o. will cover the desired frequencies from 3.5 to 4.0 mc. —30—

AN EXCEPTIONAL, NEW THIRTY-WATT AMPLIFIER • HANDLES SIXTY-WATT PEAKS!

It's New! It's Fabulous!

THE FISHER

30-Watt Amplifier

MODEL 80-AZ

ANOTHER FISHER FIRST — our great new 30-watt amplifier with *PowerScope*, a Peak Power Indicator calibrated in watts to show instantly the peak load on your speaker system. The new FISHER 80-AZ Amplifier is the first with a positive indicator to prevent voice coil damage. The Model 80-AZ is magnificent in appearance and quality.

Incomparable Features of THE FISHER Model 80-AZ

■ High output — less than 0.5% distortion at 30 watts; less than 0.05% at 10 watts. Handles 60-watt peaks. ■ Intermodulation distortion less than 0.5% at 25 watts and 0.2% at 10 watts. ■ Uniform response 10 to 50,000 cycles; within 0.1 db from 20 to 20,000 cycles. ■ Power output is constant within 1 db at 30 watts, from 15 to 35,000 cycles. ■ Hum and noise level better than 96 db below full output! ■ Three separate feedback loops for lowest distortion and superior transient response. ■ Unique cathode feedback circuit for triode performance with the efficiency of tetrodes. ■ Output transformer has interleaved windings and a grain-oriented steel core. ■ Three Controls: PowerScope, Z-Matic and Input Level. ■ Handsome, brushed-brass control panel (with sufficient cable for built-in installations.) ■ Tube Complement: 1—12AT7, 1—12AU7A, 2—EL-37, 1—5V4-G, 1—PowerScope Indicator, 1—Regulator. ■ 8- and 16-ohm outputs. ■ SIZE: 15½ x 4¼ x 6⅛" high. WEIGHT: 22 lbs.

Price Only $99.50

Price Slightly Higher West of the Rockies

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Superior's new Model 670-A

SUPER METER

A COMBINATION VOLT-OHM MILLIAMMETER PLUS CAPACITY REACTANCE INDUCTANCE AND DECIBEL MEASUREMENTS

SPECIFICATIONS:

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes
RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Good-Bad scale for checking quality of electrolytic condensers)
REACTANCE: 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms
INDUCTANCE: .15 to 7 Henries 7 to 7,000 Henries
DECIBELS: −6 to +18 +14 to +38 +34 to +58

ADDED FEATURE:

Built-in ISOLATION TRANSFORMER reduces possibility of burning out meter through misuse.

The Model 670-A comes housed in a rugged, crackle-finished steel cabinet complete with test leads and operating instructions.

$28.40 NET

Superior's new streamlined Model TC-55

TUBE TESTER

QUICKLY AND EFFICIENTLY TESTS RADIO AND TV TUBES INCLUDING: SEVEN PIN MINIATURES; EIGHT PIN SUBMINARS, OCTALS AND LOCTALS; NINE PIN NOVALS

YOU CAN'T INSERT A TUBE IN THE WRONG SOCKET.
It is impossible to insert the tube in the wrong socket when using the new Model TC-55. Separate sockets are used, one for each type of tube base. If the tube fits in the socket it can be Tested.

"FREE-POINT" ELEMENT SWITCHING SYSTEM.
The Model TC-55 incorporates a newly designed element selector switch system which reduces the possibility of obsolescence to an absolute minimum. Any pin may be used as a filament pin and the voltage applied between that pin and any other pin, or even the "top-cap."

CHECKS FOR SHORTS AND LEAKAGES BETWEEN ALL ELEMENTS.
The Model TC-55 provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals.

ELEMENTAL SWITCHES ARE NUMBERED IN STRICT ACCORDANCE WITH R.M.A. SPECIFICATIONS.
One of the most important improvements, we believe, is the fact that the 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system.
Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test.

The Model TC-55 comes complete with operating instructions and charts. Use it on the bench—use it for field calls. A streamlined carrying case, included at no extra charge, accommodates the tester and book of instructions.

$26.95 NET

About Testing Picture-Tubes...

Of course you can buy an "adapter" which theoretically will convert your standard Tube Tester into a picture-tube tester. Sounds fine—but—it simply doesn't work out that way!
We do not make nor do we recommend use of C.R.T. adapters because a Cathode Ray Tube is a very complex device and to properly test it, you need an instrument designed exclusively to test C. R. Tubes and nothing else. As compared to a make-shift adapter, which sells for about five dollars, our Model TV-40 C.R.T. Tube Tester sells for $15.85. But, if you believe that Television is here to stay, then you must agree that the difference in price is more than justified by the many years of valuable service you will get out of this indispensable instrument.
Incidentally, the Model TV-40 is the only low-priced C.R.T. Tube Tester, which includes a real meter. Neons are fine for gadgets and electric-line testers, but there is no substitute for a meter with an honest-to-goodness emission reading scale.

Superior's New Model TV-40

C.R.T. TUBE TESTER

Tests *all* magnetically deflected tubes...in the set...out of the set...in the carton!!

SPECIFICATIONS:

- Tests *all* magnetically deflected picture tubes from 7 inch to 30 inch types.
- Tests for quality by the well established emission method. All readings on "Good-Bad" scale.
- Tests for inter-element shorts and leakages up to 5 megohms.
- Test for open elements.

EASY TO USE: Simply insert line cord into any 110 volt A.C. outlet, then attach tester socket to tube base (*no trap need not be on tube*). Throw switch up for quality test . . . read direct on Good-Bad scale. Throw switch down for all leakage tests.

Model TV-40 C.R.T. Tube Tester comes absolutely complete—nothing else to buy. Housed in round cornered, molded bakelite case. Only

$15.85 NET

SHIPPED ON APPROVAL

NO MONEY WITH ORDER — NO C.O.D.

Try any of the above instruments for 10 days before you buy. If completely satisfied *then* send down payment and pay balance as indicated on coupon. No Interest or Finance Charges Added! If not completely satisfied return unit to us, no explanation necessary.

MOSS ELECTRONIC DISTRIBUTING CO., INC.
Dept. D-189, 3849 Tenth Ave., New York 34, N. Y.

Please send me the units checked. I agree to pay down payment within 10 days and to pay the monthly balance as shown. It is understood there will be no finance, interest or any other charges, provided I send my monthly payments when due. It is further understood that should I fail to make payment when due, the full unpaid balance shall become immediately due and payable.

Name .....
Address .....
City ..... Zone.... State.....

☐ Model 670-A..... Total Price **$28.40** $7.40 within 10 days. Balance $3.50 monthly for 6 months.

☐ Model TC-55..... Total Price **$26.95** $6.95 within 10 days. Balance $5.00 monthly for 4 months.

☐ Model TV-40..... Total Price **$15.85** $3.85 within 10 days. Balance $4.00 monthly for 3 months.

The Model TV-50 GENOMETER

A versatile all-inclusive GENERATOR which provides ALL the outputs for servicing:

A. M. Radio F. M. Radio Amplifiers Black and White TV Color TV

7 Signal Generators in One!

- ✔ *R. F. Signal Generator for A.M.*
- ✔ *R. F. Signal Generator for F.M.*
- ✔ *Audio Frequency Generator*
- ✔ *Bar Generator*
- ✔ *Cross Hatch Generator*
- ✔ *Color Dot Pattern Generator*
- ✔ *Marker Generator*

SPECIFICATIONS:

R. F. SIGNAL GENERATOR:

The Model TV-50 Genometer provides *complete* coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics. Accuracy and stability are assured by use of permeability trimmed Hi-Q coils. R.F. is available *separately*, modulated by the fixed *400 cycle sine-wave* audio or modulated by the *variable* 300 cycle to 20,000 cycle variable audio. Provision has also been made for injection of any external modulating source.

VARIABLE AUDIO FREQUENCY GENERATOR:

In addition to a fixed 400 cycle sine-wave audio, the Model TV-50 Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal. This service is used for checking distortion in amplifiers, measuring amplifier gain, trouble shooting hearing aids, etc.

BAR GENERATOR:

This feature of the Model TV-50 Genometer will permit you to throw an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars. A Bar Generator is acknowledged to provide the quickest and most efficient way of adjusting TV linearity controls. The Model TV-50 employs a recently improved Bar Generator circuit which assures stable never-shifting vertical and horizontal bars.

CROSS HATCH GENERATOR:

The Model TV-50 Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting, horizontal and vertical lines *interlaced* to provide a stable cross-hatch effect. This service is used primarily for correct ion trap positioning and for adjustment of linearity.

DOT PATTERN GENERATOR *(For Color TV)*

Although you will be able to use most of your regular standard equipment for servicing Color TV, the one addition which is a "must" is a Dot Pattern Generator. The Dot Pattern projected on any color TV Receiver tube by the Model TV-50 will enable you to adjust for *proper color convergence*. When all controls and circuits are in proper alignment, the resulting pattern will consist of a sharp white dot pattern on a black background. One or more circuit or control deviations will result in a dot pattern out of convergence, with the blue, red and green dots in overlapping dot patterns.

MARKER GENERATOR:

The Model TV-50 includes *all* the most frequently needed marker points. Because of the ever-changing and ever-increasing number of such points required, we decided against using crystal holders. We instead adjust each marker point against precise laboratory standards. The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc. (3579 Kc. is the color burst frequency.)

The Model TV-50 comes absolutely complete with shielded leads and operating instructions. Only _____

$47.50 NET

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Try it for 10 days before you buy. If completely satisfied *then* send $11.50 and pay balance at rate of $6.00 per month for 6 months. **No Interest or Finance Charges Added!** If not completely satisfied return unit to us, no explanation necessary.

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Please rush one Model TV-50. I agree to pay $11.50 within 10 days and to pay $6.00 per month thereafter. It is understood there will be no finance, interest or any other charges, provided I send my monthly payments when due. It is further understood that should I fail to make payment when due, the full unpaid balance shall become immediately due and payable.

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Address.....

City.....Zone....State.....

DOUBLE
MANPOWER
WITH SAME PAYROLL

by using a **Radion**
BATTERY OPERATED
Field Strength Meter
on TV Antenna Jobs

Let one man do the work of two—in less time, with greater accuracy. He can take the meter on the roof, locate and orient the antenna by himself—even before running lead-in. On master antenna systems he checks each outlet, quickly, without guesswork. This efficiency reduces call-backs, builds confidence, makes larger profits.

If you are using two men on antenna jobs now, a Radion FSM No. 5000 can pay for itself in three weeks time. Ask your parts distributor or write for folder.

Radion
THE RADION CORPORATION
Dept. N, 1130 W. Wisconsin Ave., Chicago 14, Ill.

Shielding

(*Continued from page 49*)

do not line up with practical circuit performance.

Large degrees of shielding are provided by concentric arrangements of either successive magnetic shields or alternate magnetic and electromagnetic shields, as shown in Fig. 4. In their best formation each one should be a complete shield symmetrically spaced from its neighbors as shown in Fig. 4A.

However, practical construction and the economics of production make this rather expensive to produce and, consequently a compromise such as that shown in Fig. 4B is used, where a succession of nesting cylinders is used and usually spaced so as to retain symmetry.

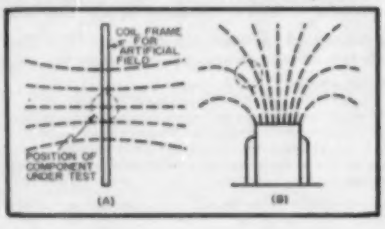
If three such cylinders are used together and each one provides 30 db of shielding by itself, the over-all shielding should add up to the region of 90 db, assuming there is no interaction between one shield and the next. This arrangement may work quite successfully provided the field against which it is shielding is uniform.

Fortunately for test purposes the specified field is a uniform one, provided by a number of turns of wire on a framework a foot square, with the shielding under test placed at the center of the framework. Here the field makes a close approximation to uniformity and is of accurately predictable field strength.

With a carefully balanced out construction of the simplified variety the shielding may be quite effective in whichever direction the unit is oriented. However, if the field is nonuniform, which is far more the usual condition, as for instance where the field is radiating from a power transformer, shown in Fig. 5B, the symmetrical distribution of the field through the different shields comprising the nest will no longer follow, and the asymmetry will tend to exaggerate the transmission of the field through the combination of shields.

Measurements have shown that under these circumstances sometimes a combination of shields intended to provide a 30 db-per-stage reduction will provide less than 30 db for the whole

Fig. 5. How the field used for testing a shielding differs from practical interference fields. (A) Standard frame producing a symmetrical field around the test position. (B) A typically distorted field which is often encountered in practice.



Need a Tube Tester?
FOLLOW THE LEADER . . .
Buy EICO®

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TUBE TESTER #625
KIT $34.95 Wired $49.95

- Tests latest 600 mil series string type tubes.

More Servicemen buy EICO TUBE TESTERS — in KIT and wired form — than any others sold through distributors. Why? Because EICO gives you the MOST value at LOWEST cost.

- Test all conventional & TV tubes and pilot lights.
- 10 individual lever-type element switches.
- Illuminated anti-backlash rollchart kept up-to-date by EICO's Engineering Dept.
- 4½" meter, 3-color "Good-Bad" scale.
- Line-adjust control. Blank socket for new tubes. Protective overload bulb.

In stock at your local jobber. Write for free Catalog RT-12 Prices 5% higher on West Coast.

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WHOSE
TURNTABLE
WAS THE HIT
of the
AUDIO SHOW?

Turn to Page 125 For The Most Important Turntable News Of The Decade!

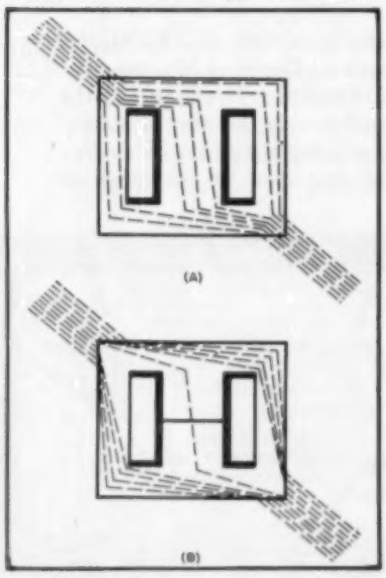
nest, although one stage by itself may still show as much as a 30 db reduction. This is due to the fact that the outermost shield, being asymmetrical, distorts the original field further from its original distorted condition and the successive shields never succeed in getting the field straightened out again.

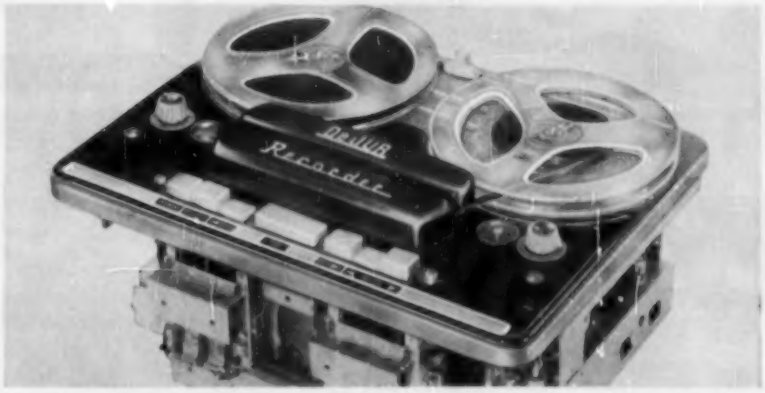
Combined Core and Shield

An interesting construction providing quite a useful degree of shielding is shown in Fig. 6. Here, instead of using either of the more usual types of core construction, the core is built up of "F" laminations so as to provide a single air gap in the center leg. With the usual construction, either from two different sets of "E" laminations, or from "E" and "I" laminations, the reluctance, through all three legs of the magnetic structure is approximately equal, and so any magnetic field reaching the laminations will divide itself so as to pass a component, of from ⅓ to ½ of the total, through the coil. Using the "F" laminations, there is a low reluctance path each way around the coil, of approximately equal reluctance, and a high reluctance path through the center of the coil. Consequently any field reaching the core assembly will be diverted around the coil.

This construction can be as effective as a complete shield. If this assembly is then symmetrically mounted in a single further shield, the total shielding is as effective as two of the more normal types of shield, and has the added advantage that it does not discriminate against the practical type of non-linear field. In other words, it gives us results under practical circumstances as good as the test figures show, which the other constructions often do not. —30—

Fig. 6. Use of a special core construction to combine the functions of core and shielding. (A) Distribution of interference flux in normal laminated core. (B) Reduction in center limb using "F" type laminations.





THE ONLY STUDIO-QUALITY RECORDER UNDER $300!

If you want to make studio-quality tapes and have less than $300 to spend for equipment, there is only *one* tape recorder you can buy—the DeJUR Dual Professional!

The DeJUR Dual Professional, operating at an economical speed of 7½ ips (up to 90 minutes of playing time for less than the cost of a good LP record!) equals or exceeds the performance of high-priced professional recorders, operating at 15 ips!

We invite you to compare the DeJUR Dual Professional with the most expensive tape recorder made. Listen to both in an A-B test. We're sure you won't be able to tell the difference!

Here are a few of the specifications (checked by an independent engineering firm and confirmed by the testing laboratories of America's leading high fidelity distributors):

FREQUENCY RESPONSE. At 7½ ips, 40 cps to 16,000 cps, ± 2 db. At 3¾ ips, 50 cps to 10,000 cps, ± 2 db.

SIGNAL TO NOISE RATIO. Noise is down 55 db. (equalling or exceeding the figure for recorders priced at $600 and up!)

WOW AND FLUTTER. Less than 0.1% at 7½ ips, 0.2% at 3¾ ips (The competitive recorder closest in performance has 0.25% and costs $100 more!) Such a low figure is made possible by the use of a heavy-duty, dual-speed, reversible *hysteresis* motor (*not* a 4-pole motor) which is independent of line voltage fluctuations.

EQUALIZATION. Professional NARTB equalization is employed so that the new commercial pre-recorded tapes can be played back with perfect "broadcast" fidelity.

INSTANT TRACK SWITCHING. Four separate heads are used — an erase head and a record-playback head for each of the dual tracks. When the end of the reel is reached on the first track, simply press a key and the tape motion is reversed, automatically recording or playing back the record track. Anyone who has fussed and fumed while changing reels in the middle of a symphony will greet this feature with cheers!

ELECTROMAGNETIC DYNAMIC BRAKING. No belts, pulleys or clutches to get out of order and deteriorate performance! Instantaneous stops in record-playback, ¼" in fast wind — without tape stress or strain!

ILLUMINATED TAPE COUNTER. Clock-like dial indicates footage so accurately tape can be indexed to a single note!

AUTOMATIC STOP. By the use of inexpensive DeJUR Aluminum foil leaders, tape motion can be stopped automatically at the end of a reel.

PUSH-BUTTON KEYBOARD. All functions are controlled by relays actuated by piano-type keys for simple, easy operation.

INPUTS. 2 high, 1 low inpedance.

These are just a few of the many specifications which make the DeJUR Dual Professional the *only* logical choice of the serious high-fidelity enthusiast.

DeJUR Dual Professional Tapedeck ready to plug into your high fidelity system—only $299.50 audiophile net.

Also available in handsome, scuff-proof carrying case complete with built-in 6-watt power amplifier, 2 electrostatic speakers, 3 PM speakers and wide range cardioid microphone for only $379.50 audiophile net.

AVAILABLE ACCESSORIES. Remote control foot switch $19.50 DeJUR wide-range cardioid mike $29.50.

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DeJUR
Dual Professional
TAPE RECORDER

The "K.O." is Fantastic!

Features the highest front-to-back ratios ever recorded for any TV antenna:

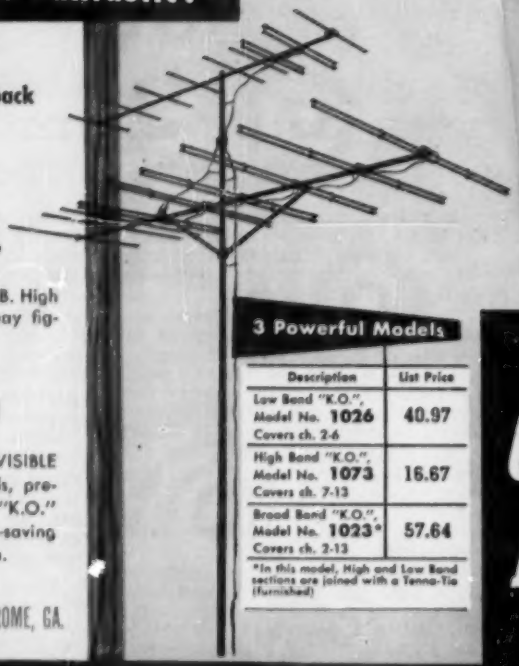
- **Low band:** from 20:1 to 50:1 relative VOLTAGE.
- **High band:** Up to 13:1 relative VOLTAGE.

High gain: Low band, 7 to 9 DB. High band, 8.5 to 10.5 DB. (Single bay figures). Balanced for COLOR.

Ends co-channel interference!
Knocks out "Venetian Blinds"!

Channel Masters "K.O." puts an INVISIBLE BARRIER in the path of rear signals, preventing co-channel interference. The "K.O." is completely preassembled with time-saving "Snap-Lock" Action. 100% aluminum.

LICENSED BY KAY-TOWNES ANTENNA CO., ROME, GA.



3 Powerful Models

Description	List Price
Low Band "K.O.", Model No. **1026** Covers ch. 2-6	40.97
High Band "K.O.", Model No. **1073** Covers ch. 7-13	16.67
Broad Band "K.O.", Model No. **1023*** Covers ch. 2-13	57.64

*In this model, High and Low Band sections are joined with a Tenna-Tie (Furnished)

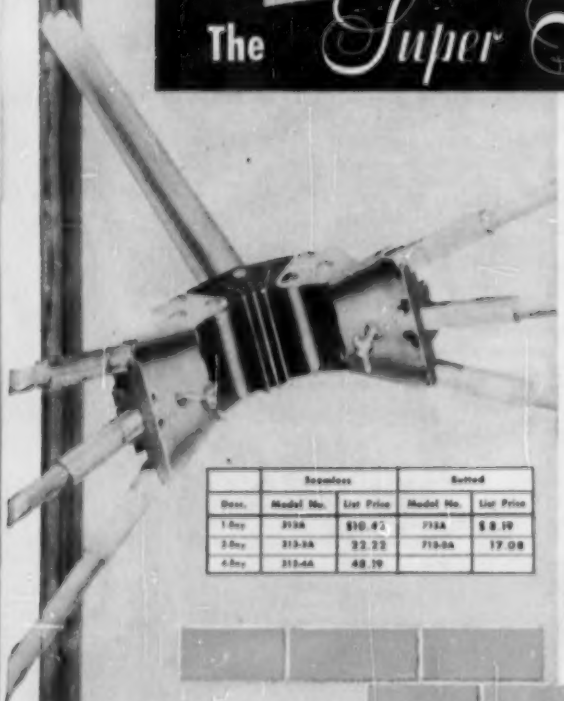
New Antennas!

New Accessories!

CHANNEL MASTER now provides you

New expanded ACCESSORIES program! Channel Master now becomes the first and only manufacturer in the industry that can supply you with every-*thing* you need for an antenna

new The Super Fan



	Seamless		Slotted	
Door.	Model No.	List Price	Model No.	List Price
1-Bay	313A	$10.42	713A	$ 8.19
2-Bay	313-2A	22.22	713-2A	17.08
4-Bay	313-4A	48.19		

- ***"Super-Sembled"!***
- ***Re-designed!***
- ***Better than ever!***

Channel Master's Super Fan is the original fan antenna. Famous for its superb quality, it has been in continuous demand for six years. *Millions* are in current use.

- **Assembles with NO HARDWARE or tightening.**
- **Massive, heavy-duty, molded fan head. Unaffected by moisture and extreme temperatures.**
- **Reinforced elements. External sleeves prevent breakage.**

CHANNEL MASTER CORP. ELLENVILLE, N. Y.

the world's largest manufacturer of television antennas and accessories

CHANNEL MASTER'S

new

TV TRANSMISSION LINE

it's got

FLEX-APPEAL!

The first TV wire to give you the benefits of **20** strands per conductor (20/33 pure copper).

Channel Master wire — at REGULAR prices — is the finest, most flexible transmission line you have ever handled. Complete range of web thicknesses available. Colorful display packaging.

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- Needle sharp point, made possible by finer thread. Easier to work in wood. Prevents slipping on mast.
- STANDOUT buckle has **8** machined threads.
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All popular types and sizes available, including full assortment of specialized hardware. See your Channel Master distributor

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New Hi-Fi-Audio Equipment

PC AMP-PREAMP

Harmon-Kardon, Inc., of Westbury, Long Island, New York, is now offering a low-priced amplifier-preamp that employs printed circuitry throughout.

The "Prelude" Model PC-200 includes many circuit features normally found

only in more expensive units. Dip soldered, copper-clad laminated phenolic board is used for all wiring yet is so arranged that mechanical disassembly can be made whenever necessary.

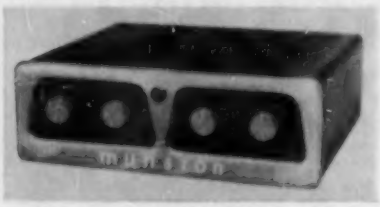
Rated at 10-watts output, this amplifier includes a preamp with inputs for phono, tuner, as well as tape input which provides correct preamplifier equalization for tape recorder heads. A tape output, unaffected by the tone controls, is also featured.

TEN-WATT AMPLIFIER

Munston Manufacturing Co., Beech Street, Islip, New York, is now in production on a new 10-watt amplifier which is being marketed as the "Maestro."

The new unit incorporates the company's "Dynamic B-T" circuit which offers a specially-designed dynamic control of bass and treble response plus calibrated tone controls.

Frequency response is 20 to 20,000 cps, ± ½ db. Equalization is continuously variable. Tape and phono tone controls are provided. Although the



amplifier measures only 3⅞" x 9⁵⁄₁₆" x 8⁵⁄₁₆", adequate output is provided for even the largest living rooms.

NEW AMSCO TAPE RECORDER

DeJur-Amsco Corporation, 4501 Northern Boulevard, Long Island City 1, N. Y., recently unveiled a medium-priced tape recorder which is powered by a heavy-duty hysteresis motor.

The recorder, Model TK-820, is a dual-track unit with push-button track reversal. This latter feature permits recording or playback on either track of a tape without rewinding or rethreading.

The synchronous reversible hysteresis motor provides two speeds for recording at either 3¾ or 7½ ips. Instantaneous starts and stops are possible by means of dynamic electromagnetic clutches and brakes which eliminate tape strain and stress.

All functions of the recorder are electronically controlled through a piano-type key switchboard relay operation. Other features include four separate erase and record-playback heads, a magic eye level indicator for recording, and a frequency compensated loudness control for playback. A special

input selector switch allows three signal sources to remain permanently connected.

KARLSON ENCLOSURE

Karlson Associates, Inc., 1610 Neck Road, Brooklyn 29, New York, is now offering a new line of loudspeaker enclosures utilizing the firm's patented principle.

These enclosures, designed specifically for use with 8" speakers, makes possible good bass and definition of tone in a unit which will fit in a bookcase. There are five different models currently available. The basic unit is an easy-to-assemble kit. There is a factory-assembled kit in unfinished wood, a painted unit available in three colors, and a deluxe model finished in either blonde or mahogany plastic, in the line as well.

The kit comes complete with all necessary parts precut, ready for assembly. Only a hammer and glue are necessary for the assembly. The assembled unit weighs about 15 pounds and measures 17¼" x 11¾" x 10".

A 32-page booklet describing this new line is available without charge. Write the company direct and ask for Booklet 139.

PORTABLE TAPE RECORDER

A new low-cost, lightweight portable tape recorder, the Model 556, has been developed for the mass market by *Telectrosonic Corporation* of 35-18 37th Street, Long Island City 1, New York.

The recorder provides simplicity of operation with dual track recording at 3¾ ips; fast forward and rewind; essentially flat frequency response; full hour recording on a single 5" reel; re-

cording level indicator; and easy threading for foolproof operation.

Accessories provided include a crystal type microphone with stand; cord for recorder connection with radio, phonograph, or telephone; 5" reel with tape; pickup reel; and an a.c. line cord.

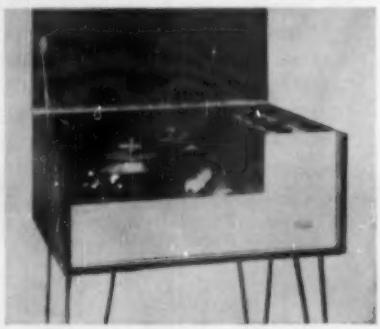
The entire unit is housed in a two-tone airplane cloth, luggage-type carrying case measuring 7" x 10" x 11½" and weighing slightly less than 16 pounds.

RECORD REPRODUCER

Altec Lansing Corporation, 9356 Santa Monica Boulevard, Beverly Hills, California, has recently added the Model 901A record reproducer to its line of audio equipment.

This new unit, which is available in either blonde or mahogany cabinets, contains the firm's A-339A 10-watt amplifier and control preamp, a *Collaro* three-speed changer, and a dual-stylus *G-E* variable reluctance cartridge.

The 901A "Melodist" is designed to be used with any of the company's five



complete speaker systems. The reproducer itself contains no speaker system.

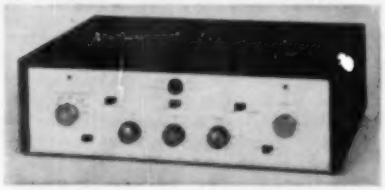
TRANSCRIPTION AMPLIFIER

Hermon Hosmer Scott, Inc., 385 Putnam Ave., Cambridge 39, Mass., is now offering a new model of its 99 amplifier as the Model 99-B.

The new unit offers a full 22-watt power amplifier plus a flexible equalizer-preamp in one compact case. A 5-position record compensator equalizes virtually all records. An adjustable rumble filter and record scratch filter reduce record noise and turntable rumble.

Two magnetic inputs, switched on the panel, allow the use of both changer and turntable. Special provisions for playback of recorded tape through the amplifier are also included. Separate bass and treble controls each offer both boost and attenuation. Continuously variable loudness compensation, with volume-loudness switch, gives perfect tonal balance at all listening levels. There is an input selector switch for two magnetic pickups, crystal or constant amplitude pickup, three high-level inputs, and NARTB tape playback.

Frequency response is flat from 20 to 30,000 cps. Hum is better than 80 db



below maximum output and harmonic distortion is less than 88 per-cent.

MINIATURE RIBBON MIKE

Fenton Company, 15 Moore St., New York 4, N. Y., is expanding its line of miniature ribbon mikes for broadcast, studio, and general-purpose applications with the Danish-built B&O-50 unit.

This new 50-ohm impedance pressure gradient full-bass mike is the third ribbon mike to be offered by the company this year. It has a perfect figure-8 directional pattern and amazing sensitivity. The mike uses anisotropic permanent Ticonal E magnets in a special and novel magnetic circuit having only negligible leakage.

The mike includes a three-way switch which offers "close-talk," "music," and "off" positions, and a ball swivel mounting for easy tilting in any direction. The snap-action stand connector, with standard ⅝" x 27 threads, is simply attached to standard mike stands and booms. The mike is shipped with 20 feet of shielded, balanced, 3-conductor cable.

NEW TYPE TONE ARM

Bard Record Company, Inc., 66 Mechanic St., New Rochelle, N. Y., is now introducing its new "Ortho-Sonic V/4" tone arm to audiophiles, broadcasting stations, etc.

According to the manufacturer tracking error has been completely eliminated since the cartridge moves radially from the edge to the center of the record. The stylus will not scratch the record since the cartridge is never touched by hand. With a slight tilt of the arm the stylus is either placed

(*Continued on page* 124)

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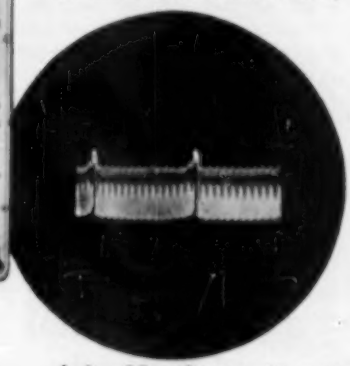
Through time saved in TV Trouble-Shooting

GENERATES ACTUAL TV COMPOSITE WAVEFORM



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Easy to Use:

Horizontal and Vertical Framing Frequencies . . . this feature, for the first time, enables you to intelligently attack deflection circuit troubles such as horizontal streaking and horizontal foldover.

RF Output . . . covers all low and high channels and is calibrated directly in microvolts for sensitivity measurements to permit receiver adjustment for fringe or overload operation.

Actual TV Transmitter . . . a composite TV signal or program can be placed on any channel of a TV receiver.

Signal Tracing . . . the 650C is especially useful for signal tracing stage by stage from antenna to picture tube or for use in substitution techniques to by-pass any stage in quickly isolating troubles.

The 650C generates an actual Composite Video waveshape, 60 cycle Vertical Sync Pulse, 900 Cycle Pulse, 60 Cycle Vertical Sawtooth . . . plus, individual patterns at any signal strength within 0-10,000 microvolts. (Vertical or Horizontal Lines, Cross-Hatch, White or Black Dots or Framing Frequencies only.)

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Single-Sideband Systems

By **FRITZ FRANKE**
The Hallicrafters Company

Engineering details on the commercially-available single sideband equipment pictured on this month's front cover.

IT HAS been known for many years that to transmit and receive AM signals, the carrier at the transmitter may be removed or suppressed if at the receiver detector a locally generated carrier is re-inserted. It also has been known that it is not necessary to transmit both sidebands of the AM signals, since one sideband contains the same amount of intelligence as the other. This is the basic concept of the single sideband suppressed carrier mode of radiotelephone transmission which has been used commercially for a number of years in long distance carrier telephone systems as well as for transatlantic radiotelephone circuits.

The major advantage of SSB results from the fact only one half the spectrum space is required since only one sideband generally is used. As the receiver is then only required to pass one sideband, its selectivity may be reduced from 6 kc. to 3 kc. for a speech channel, thus improving the signal-to-noise ratio at the receiver. As the receiver must supply a substitute carrier to replace the carrier removed at the transmitter, this local carrier also will be relatively free from noise with still further improvement in signal-to-noise ratio.

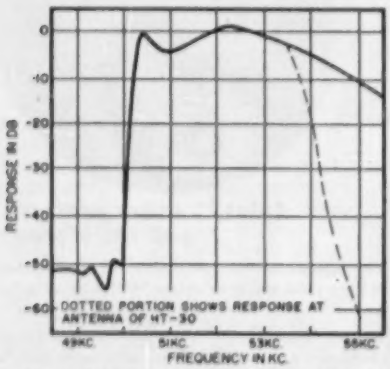


Fig. 1. Response curve of the 50 kc. single-sideband filter used with the Model HT-30.

Many different approaches to calculating the over-all circuit improvement by the use of single sideband over AM have been made. All show increases of at least 3 db and some range higher than 9 db. Thus, the effect of SSB can be considered equivalent to increasing the output power of an AM transmitter from two to eight times. For amateur application, a conservative rating of 500-watt plate input SSB final amplifier is equal to a 1000-watt high level AM stage. On a power output basis these same units would produce about 330 watts peak envelope power and 700 watts carrier, respectively.

Actually, any receiver equipped with a beat frequency oscillator may be used to receive SSB. However, a receiver which has been designed with SSB requirements in mind will give better performance without impairing its functions for AM and CW. As the receiver must supply a local carrier to detect the SSB signal, it is easy to employ the b.f.o. for this carrier source. The b.f.o., as well as the receiver itself, must be stable since the local carrier and converting oscillator must remain at least within ± 50 cycles of the equivalent untransmitted carrier. Assume that a 14,300 kc. SSB signal is tuned in; the b.f.o. and receiver must remain stable to 1 part in 143,000. Furthermore, to obtain the maximum detection efficiencies, the b.f.o. voltage delivered to the detector must be 5 to 10 times greater than that required for CW reception.

Two basic systems are available for the generation of SSB signals at the transmitter: These are the filter system and the phasing system. Commercial interests have employed the filter system which was the first to be developed. Much can be said in its favor because of its stability in suppression of unwanted sideband energy. For certain limited applications, the phasing system has merit when carefully operated but it is doubtful if the unwanted sideband energy can be suppressed as well as in the filter system unless special care is taken.

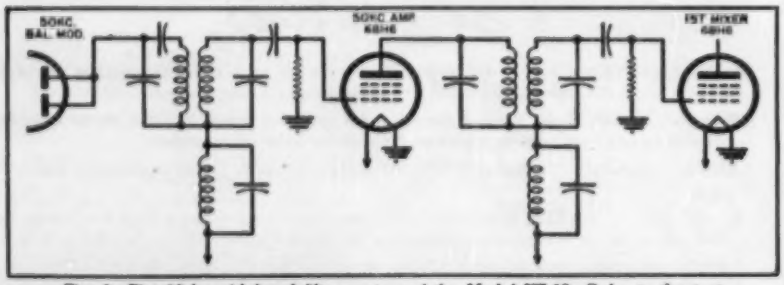
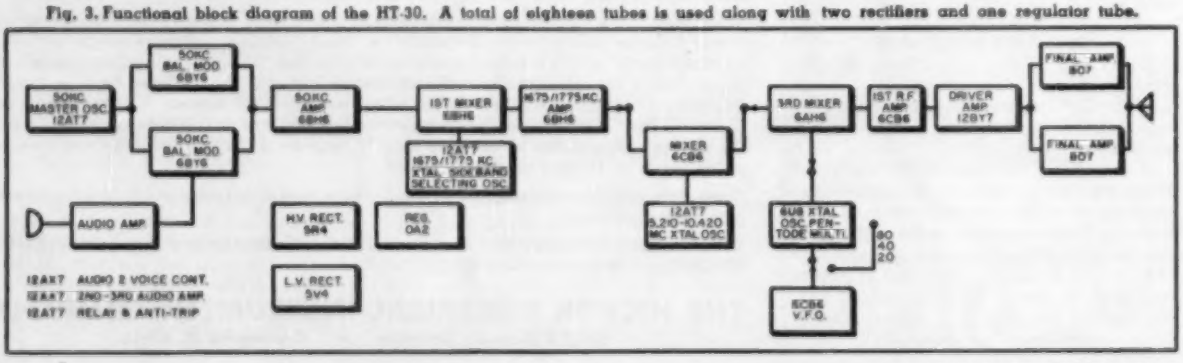
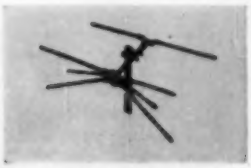


Fig. 2. The 50 kc. sideband filter system of the Model HT-30. Refer to the text.

Fig. 3. Functional block diagram of the HT-30. A total of eighteen tubes is used along with two rectifiers and one regulator tube.





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Eight elements; for low channels.
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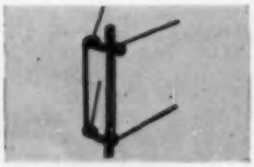

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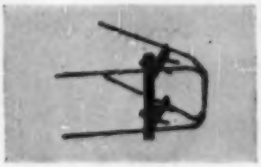

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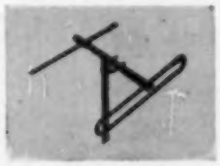

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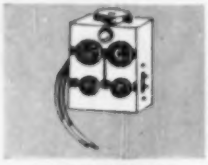

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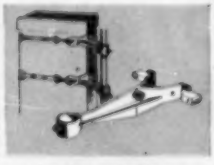

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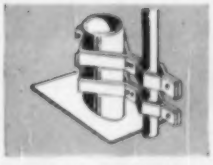

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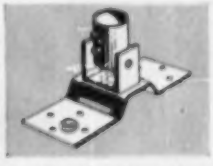

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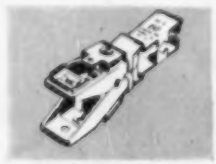

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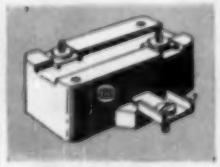

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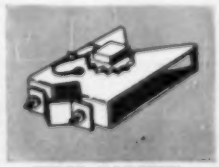

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In a filter system, a balanced modulator is used primarily to provide a fairly high degree of carrier suppression. This is done to avoid additional complexities in the sideband filter which generally follows the balanced modulator. It is most feasible to generate the carrier and sidebands at a relatively low frequency (in the range of 25 to 100 kc.), as sideband filters can be economically produced in the range of 25 to 100 kc. Balanced modulators are also many times more stable at 50 kc. than at 2 to 10 mc. At least one prominent radio manufacturer employs only one sideband filter, in place of the normal two, and in the heterodyning process inverts the selected sideband so the operator has the choice of upper or lower sideband transmission.

The filter system, response curves, and functional block diagram of this transmitter are shown in Figs. 1, 2, and 3. It should be noted that after the carrier is suppressed, all following amplifier stages must be class A or class B linear. Furthermore, frequency multiplication cannot be used, only heterodyning processes to convert to a higher frequency.

In the phasing system of sideband generation, a double balanced modulator is fed two r.f. signals of the same frequency and amplitude but differing in phase by 90°. The audio signal is also fed by two paths into the balanced modulator. The voltage in these paths has a 90° phase difference and a voltage difference of about 3.49:1. The balanced modulator provides a reasonable degree of carrier suppression and a vector analysis shows that one sideband is suppressed while the second is increased.

The majority of the phasing-type SSB units generate the sideband at about 9 mc. and heterodyne the desired sideband to the final output frequency. Fig. 4 is a block diagram of the essential parts of a phasing-type unit.

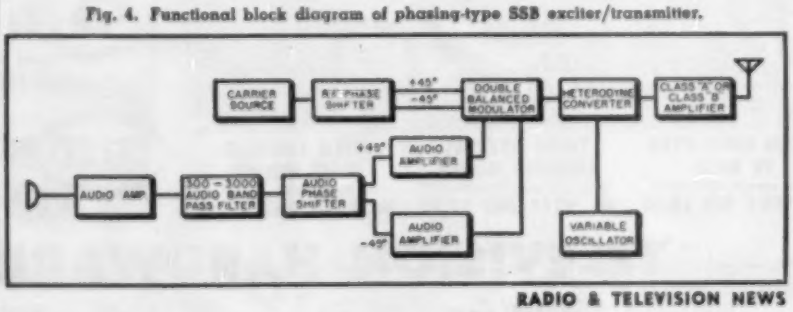
As the degree of sideband suppression and enhancement is dependent upon maintaining exactly 45° phase difference, and a certain voltage difference in the audio frequency paths, sideband suppression can become quite difficult to maintain in the field. Commonly used audio phase shift networks, as designed, will provide the required shift within ± 1½° only through the audio range of 300-3000 cycles. Therefore, it is important to employ a fairly good audio bandpass filter preceding the phase shift network to assure adequate sideband suppression at frequencies below 300 cycles and above 3000 cycles. When both systems of sideband generation are compared on the basis of actual, carefully made engineering measurements, it is possible to achieve essentially the same degree of carrier and unwanted sideband suppression in each. But, to achieve the same results with a phasing system, the cost of the components will equal or exceed a filter system and the inherent reliability of the filter system will not be obtained.

From time to time in the past twenty-five years, voice-controlled radiotelephone transmitters have found limited application, but with the improved circuit efficiency of SSB, their great convenience of operation has been fully achieved. It is a new thrill in the amateur field to "zero in" an SSB transmitter and receiver on a "round table" of five or more other hams and through a voice-control system engage in a discussion as though the others were in the same room.

The voice control system in the *Hallicrafters* HT-30 single sideband transmitter/exciter operates by amplifying and rectifying some audio voltage developed by the microphone. The rectified d.c. voltage operates a quick-acting relay which removes blocking bias from r.f. stages in the exciter, thus placing the transmitter on the air. The relay has additional contacts to disable the receiver and also operates an antenna changeover relay. Because any sound reaching the microphone from the receiver loudspeaker would trip the relay, a portion of the receiver audio output is fed into the relay system in opposition to that of the microphone. The effective result is that the relay can only be tripped when it receives sound level from the operator's voice. As all these circuits are rather high speed in their operation, and the talking speed varies with individuals, an adjustable holding or delay control is provided to hold the transmitter "on" between syllables and words.

An outstanding example of a completely coordinated amateur radio station wherein the fullest advantages of SSB as well as AM and CW have been provided in the receiver, exciter, and final amplifier is shown on this month's cover. This new *Hallicrafters* SR-500 station is comprised of an SX-100 receiver, HT-30 exciter, and an HT-31 linear amplifier. In addition, full antenna switching for all-band operation is provided. This modern console assembly with operating desk is completely enclosed and all power circuits are controlled through a key-lock to prevent unauthorized operation of the equipment. —30—

Fig. 4. Functional block diagram of phasing-type SSB exciter/transmitter.



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Spot Radio News

(*Continued from page 18*)

recording pulse in one or more of the information channels, and if the heads are closely spaced, this pulse of current through an information head induces a signal into the sprocket channel head, that may be from 20 to 50 times the amplitude of the average tape signal. In a conventional amplifier, this large crosstalk signal would undoubtedly cause grid blocking as well as spurious signals, so the sprocket channel amplifier has to be of special design.

In experimenting with means to reduce the crosstalk, it was found that shielding between the heads offered some help, but the residual signal-to-noise ratio of 20 to 1 was still intolerable. Since the sprocket head is located between the two recording heads, another plan of attack was tried; the windings of the recording heads were oriented so that they were in opposition to each other, causing their magnetic fields to cancel. However, even this approach did not solve the problem completely; some crosstalk was still present because of slight geometric differences between the heads, minor differences in the signal levels and some capacitive coupling to the sprocket head. To suppress further the effects of crosstalk signal, advantage was taken of the condition that the two signals, with which the sprocket channel is concerned, are composed of widely different frequency components. The desired signal from the tape consists of packets of nearly pure sine waves, whereas the undesired crosstalk signal is made up primarily of much higher-frequency components, since it is induced by a recording pulse which is only two microseconds in duration. This information made it possible to design and build a low-pass amplifier for the sprocket channel. At the output of this amplifier, the crosstalk signal was reduced to only one-fifth the amplitude of the tape signal. Thus attenuated, the crosstalk presented no further problem, since it was found that it was within the range of conventional amplitude-discrimination means.

During extensive laboratory trials, to determine the reliability of the reading and recording circuitry at different recording densities, several runs of one to three-million digits were recorded and read at densities of 500 to 600 digits per inch without apparent errors.

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3704	3712	3720	3728	3736	3744
3705	3713	3721	3729	3737	3745
3706	3714	3722	3730	3738	3746
3707	3715	3723	3731	3739	3747
3708	3716	3724	3732	3740	3748
					3749

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E-X-T-E-N-D-E-D

7151	7159	7167	7175	7183	7191
7152	7160	7168	7176	7184	7192
7153	7161	7169	7177	7185	7193
7154	7162	7170	7178	7186	7194
7155	7163	7171	7179	7187	7195
7156	7164	7172	7180	7188	7196
7157	7165	7173	7181	7189	7197
7158	7166	7174	7182	7190	7198
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3578	3584	3590	3596
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1129	2115	2380	2740	3095	3640	4445	5127.5	5782.5	6206.6	6740	7325	7673.3	7966.7	7958.3	8160	8340	8550
1150	2120	2385	2750	3100	3655	4450	5135	5800	6225	6750	7333.3	7675	7970	7980	8150.3	8341.7	8556.3
1180	2125	2390	2765	3105	3660	4460	5165	5806.7	6235	6773.3	7340	7680	7973.3	7966.7	8160	8350	8560
1195	2135	2395	2770	3110	3700	4485	5180	5820	6240	6775	7341.7	7683.3	7975	7970	8163.4	8358.3	8566.7
1900	2140	2400	2775	3115	3760	4490	5205	5825	6250	6800	7350	7690	7980	7973.3	8166.7	8360	8570
1910	2145	2405	2780	3120	3800	4495	5235	5840	6273.3	6806.6	7358.3	7691.7	7983.3	7975	8170	8366.7	8575
1920	2150	2410	2785	3125	3825	4520	5245	5850	6275	6815	7366.7	7700	7990	7980	8173.3	8370	8580
1925	2155	2415	2790	3130	3840	4535	5285	5852.5	6300	6825	7373.3	7706.6	7991.7	7983.3	8175	8375	8583.3
1930	2170	2425	2875	3135	3885	4540	5295	5860	6306.6	6840	7375	7708.3	7995	7990	8180	8380	8590
1935	2185	2430	2880	3140	3940	4565	5300	5873.5	6315	6850	7383.3	7710	7996.6	7991.7	8183.3	8383.3	8591.7
1940	2200	2435	2910	3145	3965	4580	5305	5875	6325	6873.3	7391.7	7716.7	7998.3	8000	8190	8390	8600
1942.5	2205	2442.5	2915	3150	3950	4610	5327.5	5880	6335	6875	7400	7670	7710	8005.6	8191.7	8391.7	8608.3
1960	2210	2450	2920	3155	3955	4620	5335	5892.5	6340	6900	7406.6	7625	7816.7	8008.3	8200	8400	8610
1965	2215	2460	2925	3160	3960	4635	5385	5900	6350	6906.6	7408.3	7630	7820	8016.7	8206.6	8400.3	8616.7
1970	2220	2465	2930	3165	3995	4640	5397.5	5906.7	6362.5	6925	7416.7	7633.3	7825	8020	8208.3	8410	8620
1972.5	2225	2470	2935	3170	4000	4680	5435	5907.5	6373.3	6940	7425	7640	7830	8025	8210	8416.7	8625
1975	2230	2475	2940	3175	4035	4695	5437.5	5920	6375	6950	7433.3	7641.7	7833.3	8030	8216.7	8420	8630
1977.5	2235	2480	2945	3180	4045	4710	5485	5925	6400	6973.3	7440	7650	7840	8033.3	8220	8425	8633.3
1980	2245	2485	2950	3185	4080	4735	5500	5940	6405	6975	7441.7	7658.3	7841.7	8040	8225	8430	8640
1990	2250	2520	2955	3190	4090	4755	5545	5950	6406.6	7000	7450	7660	7850	8041.7	8233.3	8433.3	8641.7
1995	2258	2525	2960	3195	4095	4780	5562.5	5955	6425	7006.6	7458.3	7666.7	7858.3	8050	8240	8440	8650
1997.5	2260	2532.5	2965	3202.5	4110	4785	5587.5	5973.3	6440	7025	7466.7	7670	7860	8058.3	8241.7	8441.7	8658.3
2005	2265	2535	2970	3205	4130	4790	5633.3	5975	6450	7040	7473.3	7675	7866.7	8060	8250	8450	8660
2010	2270	2540	2975	3210	4135	4815	5635	5995	6473.3	7050	7475	7675	7870	8066.7	8258.3	8458.3	8666.7
2315	2275	2545	2980	3215	4165	4830	5645	6000	6475	7073.3	7483.3	7680	7873.3	8070	8260	8460	8670
2017.5	2280	2555	2985	3220	4175	4840	5655.5	6006.6	6500	7075	7491.7	7683.3	7875	8073.3	8266.7	8466.7	8675
2020	2282.5	2557.5	2990	3225	4180	4845	5660	6025	6506.6	7100	7500	7690	7880	8075	8270	8470	8680
2025	2285	2560	3010	3230	4210	4852.5	5677.5	6040	6525	7106.6	7508.3	7691.7	7883.3	8080	8273.3	8475	8683.3
2030	2290	2565	3015	3235	4215	4870	5677.7	6042.5	6540	7125	7508.3	7700	7890	8083.3	8275	8480	8690
2035	2295	2570	3025	3237.5	4240	4880	5687.5	6050	6550	7140	7510	7706.6	7891.7	8090	8280	8483.3	8691.7
2040	2300	2575	3030	3240	4250	4885	5700	6073.3	6573.3	7150	7516.7	7708.3	7900	8091.7	8283.3	8490	8700
2045	2305	2580	3035	3245	4255	4900	5706.7	6075	6575	7200	7520	7710	7906.6	8100	8290	8491.7	8708.3
2050	2310	2585	3040	3250	4260	4920	5722.2	6100	6600	7206.6	7525	7716.7	7908.3	8106.6	8291.7	8500	8710
2055	2315	2590	3045	3320	4295	4930	5725	6106.6	6606.6	7225	7530	7725	7910	8108.3	8300	8508.3	8716.7
2065	2320	2603.7	3050	3327.5	4300	4960	5730	6125	6625	7240	7533.3	7775	7916.7	8110	8306.6	8510	8720
2070	2325	2605	3055	3440	4310	4980	5740	6140	6640	7250	7540	7730	7920	8116.7	8308.3	8516.7	8725
2075	2330	2610	3060	3455	4330	4995	5744.4	6142.5	6650	7273.3	7541.7	7733.3	7925	8120	8310	8520	8730
2080	2335	2615	3065	3465	4340	5030	5750	6150	6673.3	7275	7550	7740	7930	8125	8316.7	8525	8733.3
2085	2340	2655	3070	3505	4360	5035	5760	6173.3	6675	7300	7558.3	7741.7	7933.3	8130	8320	8530	8740
2090	2345	2660	3075	3510	4395	5065	5773.3	6175	6700	7306.6	7560	7750	7940	8133.3	8325	8533.3	8741.7
2100	2350	2665	3080	3525	4397.5	5080	5775	6185	6706.6	7308.3	7566.7	7758.3	7941.7	8140	8330	8540	8750
2105	2355	2700	3085	3540													

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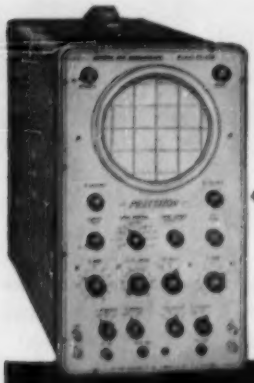

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★ **Built-in 60 cps Phasing and Blanking Controls.**

★ **All 4 Deflection Plates Available** directly (at rear), with full beam centering facilities.

★ **Tube Complement:** 12AV7 "V" Cathode Follower-Ampl. 6U8 "V" Ampl.-Phase Splitter. Two 6CL6 Push-Pull "V" Drivers. 6U8 "H" Cathode Follower-Ampl. 6C4 "H" Phase Splitter. Two 12BH7 Push-Pull "H" Drivers. 12AV7 Linear-Sweep. 6BH6 Auto-Sync. Ampl. 12AU7 Sweep Retrace Blanking Ampl. 0A2 Voltage Regulator. 5V4 Low Voltage Rect. Two 1V2 High Voltage Rect. 5CP1/A CR Tube.

★ **High Contrast, Filter Type, Calibrating Screen**

★ **Fully Licensed** under AT&T and RCA patents.

Model ES-550 Deluxe: (Illustrated) in custom-styled, blue-grey ripple finished steel cabinet; 2 color satin-brushed aluminum panel and contrasting dark blue control knobs. Case Dimensions 8¼ x 14½ x 18½ inches. Complete with all tubes, including 5CP1/A CR tube. Comprehensive Instruction Manual.

Net Price $215.00

Model ES-550 Standard: Electrically identical to above but in standard black cabinet with black anodized aluminum panel. Case Dimensions 8¼ x 14½ x 18½ inches. Complete as above.

Net Price: $210.00

***PRECISION** Test Equipment is available and on display at leading electronic parts distributors. Write directly to factory for new 1955 catalog.*

PRECISION Apparatus Company, Inc.
70-31 84th Street, Glendale 27, L. I., N. Y.
Export: 458 Broadway, New York 13, U. S. A.
Canada: Atlas Radio Corp., Ltd., 50 Wingold Ave., Toronto 10

NEW TV GRANTS SINCE FREEZE LIFT

Continuing the listing of construction permits granted by FCC since lifting of freeze. Additional stations will be carried next month.

STATE	CITY	CALL	CHANNEL	FREQUENCY	POWER*
Nevada	Las Vegas	——	13	214-216	12.9
Pennsylvania	Philadelphia	——	23	524-530	537

New Call Letter Assignments

STATE	CITY	CALL	CHANNEL	FREQUENCY
Nebraska	Hayes Center	KHOK-TV	6	82-88
Texas	Laredo	KHAD-TV	8	180-186
Texas	Odessa	KOSA-TV	7	174-180

Call Letter Change

STATE	CITY	CALL	CHANNEL	FREQUENCY
Michigan	Marquette	WDMJ-TV (Formerly WAGE-TV)	6	82-88

The gauge, which is about the size of a telephone, is connected by cable to an amplifier and is said to measure accurately to .0002 of an inch. Production parts are inserted into a measuring anvil. A thickness reading is taken electronically. The reading is indicated on a dial and at the same time is transformed into a sound tone, as well as a visual light signal.

Blind operators, wearing headphones, hear a low-pitched tone for parts that are under the proper thickness and a high-pitched tone for those parts that are over the required thickness. Parts that meet the requirements produce no tone at all.

ILLEGAL RADIATORS or boosters, whose signals seriously interfere with standard transmissions and community TV operation, were scored recently by members of the Senate. In a strongly-worded message to the FCC, Senators Wayne Morse, Warren Magnuson, and Henry M. Jackson said that the situation exists because the present rules of the Commission represent a stumbling block to the ". . . type of inexpensive, short-distance booster stations needed in many small communities." They urged that a set of rules be written promptly so that small towns can have the service the large communities have, and without interference.

"It is the responsibility of the Commission," the Senators added, "to make television service available to everyone, and the citizens of small communities should not be penalized because of the slowness of the Commission in formulating a set of regulations."

THE CONFUSED HIGH-LOW BAND program in Washington, which has stalled TV expansion, continues to affect firm assignments. While a number have filed briefs asking for permission to set up shop, formal actions have been very slow.

At this writing, only the stations listed above have received the green light.

ELECTRONICS, already hailed as America's fastest growing industry, is destined to spiral into a multi-billion dollar giant within twenty years.

So predicted the prexys of leading set makers and broadcasters recently. In their opinion, by 1975, the electronics industry will represent a $30 to $35-billion business.

A substantial portion of this growth, it was said, would be due to the tremendous expansion of the TV field. It was believed that there will be over 90 million sets in operation within the next two decades, and ninety per-cent of these receivers will feature color.

Other dynamic facts highlighting the bright future disclosed that the extraordinary surge of the new developments we've seen during the past decade will be even mightier in the years to come; 80 per-cent of the business done by electronic companies ten to twenty years hence will be in products and services we do not have today.

Certainly a buoyant picture for the road ahead.....L. W.

NEW TV STATIONS ON THE AIR

(As of November 28, 1955)

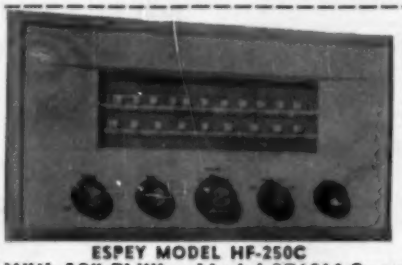
The following new stations bring the lists published in previous issues up to date.

STATE, CITY	STATION	CHANNEL	FREQUENCY RANGE (IN MC.)	VIDEO WAVELENGTH (IN FT.)	VIDEO POWER (IN KW.)
Arkansas					
Little Rock	KTHV	11	198-204	4.93	316
Nebraska					
Hayes Center	KHTL-TV	6	82-88	11.8	28
North Dakota					
Bismarck	KBMB-TV	12	204-210	4.79	30
Canada					
Lethbridge, Alberta	CJLH-TV	7	174-180	5.61	182.8
Mexico					
Monterrey	XHNL-TV	10	192-198	5.08	0.3

The frequency of the video carrier = 1.25 + channel lower freq. limit. Total number of TV stations now on the air in U.S.: 469 (116 of which are u. h. f.).

14 TUBE ESPEY HI-FI CUSTOM FM-AM CHASSIS $84.95

LATEST 1956 MODEL WITH RESPONSE FROM 10 TO 22,000 CPS



ESPEY MODEL HF-250C

With 12" Phillips Model 9760M Speaker....$ 99.95
With 12" Phillips Model 9762M Speaker.... 119.95

Buy either of these new Duotone "Norelco" speakers with your Espey chassis. Made by Phillips of Holland. Features Ticonal magnet, improved cone design, built-in mechanical cross-over and copper ring filled info air gap keeps voice coil impedance independent of frequency.

Model 9760M, $84.95 list 12" Phillips speaker, response 30 to 20,000 cps, rated at 20 watts with Model HF-250C Espey chassis, both for only $99.95.

Model 9762M, $99.95 list 12" Phillips speaker, response 22 to 20,000 cps, rated at 20 watts with Model HF-250C Espey chassis, both for only $119.95.

With 15" Utah Coaxial PM Speaker.....$99.95

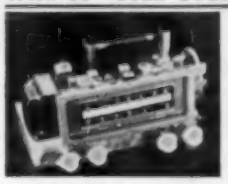
NEW MODEL HF-250C. A FULL HIGH FIDELITY AUDIO AMPLIFIER AND FM-AM TUNER—ALL ON ONE CHASSIS

- ★ PUSH-PULL 6V6 OUTPUT
- ★ TWIN TONE CONTROLS
- ★ INPUTS FOR CRYSTAL OR V.R. PHONO, TAPE OR TV
- ★ WILLIAMSON TYPE CIRCUIT
- ★ ULTRA-LINEAR RESPONSE

SALE PRICE **$84.95** LESS SPEAKER

New 1956 model, 14 tube FM-AM chassis. A true Hi-Fidelity receiver built by a nationally famous maker of fine custom chassis. Espey Model HF-250C, 14 tube FM-AM chassis with push-pull 6V6, 20 watt radio. You could spend $200 to $250 for a separate tuner and amplifier and not have the quality of this receiver. Ultra-Linear output used in Williamson type circuit gives frequency response of 10 to 22,000 cps. Output taps of 4, 8 and 16 ohms. Separate RF stages for FM and AM assure high sensitivity. Temperature compensated FM front end for minimum drift. Separate bass and treble tone controls. Pre-amp for all types of magnetic cartridges. 2nd input for crystal phono, tape recorder or TV. 3 position equalizer for accurate reproduction of all records. Built-in antennas for both FM and AM. Response plus or minus 1 db from 10 to 22,000 cps. Harmonic distortion less than 1%. Sensitivity: FM, 5 mv for 30 db quieting; AM, 75 mv for 6 db signal to noise ratio. Off-on-volume and equalizer are combined on a concentric control. 2 AM antennas, rear chassis. Beautiful edge lighted flywheel inertia slide rule dial. Size: 7½"x13½"x10" deep. Ship. wt. 24 lbs. (not mailable) Model HF-250C. Sale price, $84.95. With heavy duty Utah 15" coaxial PM speaker, both for only $99.95.

HI-FI FM-AM TUNER AND 10 WATT P.P. 6V6 AMPLIFIER



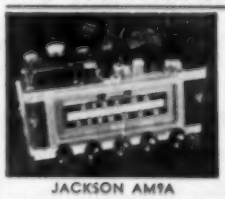
10 W. AMP.

BOTH FOR **$44.95**

9 TUBES-PLUS 2 RECTIFIERS PHONO INPUT

New Hi-Fi self-powered FM-AM tuner with 10 watt amplifier (push-pull 6V6's) on separate chassis. All you need is a record changer and speaker to have a complete home music system. 3 ft. cable connects tuner to amp. Tuner has input for crystal phono. (If changer with v.r. cartridge is purchased we will include the necessary pre-amp. at no charge.) Tuner has 6 tubes: 12AT7, 6BE6, 6-6BA6, 6AL5 and 6X4 rectifier. Amp has 2-6V6's, 6SN7 and rectifier. Full superhet circuit with AVC. 3 position tone control. 5" illuminated slide rule dial, escutcheon and knobs. Stick loop antenna for AM. Radio-FM-AM, phono selector switch, tone controls, volume control on tuner. Response 50 to 17,500 cps. Receives broadcast 540 to 1600 kc and FM 88 to 108 mc. Output matches any of the speakers shown above. No. PA9-2CH tuner and amplifier complete. Ship. wt. 22 lbs. Sale price, $44.95. CU-14V 12" coax speaker, $10.00 extra; 15" coax speaker, $20.00 extra.

9-TUBE HI-FIDELITY



JACKSON AM9A

12 Watts Audio
Dual Tone Controls
$39.95 LESS SPEAKER

RECEIVES BROADCAST 550 TO 1650 K.C.

Jackson AM9A, 12 watt hi-fi audio amplifier and broadcast tuner combined. Less than you would pay for the amp alone. Push-pull 6V6's. Response 20 to 15,000 cps. Inputs for crystal or v.r. phono and crystal or dynamic mike. Separate bass boost and treble tone controls, radio-phono switch. Shielded output matches 3.2 or 8 ohm speaker. Heavy duty 150 mil power trans. 9½" illuminated slide rule dial, 3 gang condenser with tuned R.F. and loop ant. Receives 550 to 1650 kc broadcast. Size, 13" x 9½" x 6" high. With tubes: 2-6BA6, 6AU6, 6BE6, 6SN7, 6AT6, 2-6V6 and 6V3. Knobs, escutcheon, diagram and instructions included. Model AM9A. Ship. wt. 16 lbs. Sale price, $39.95. CU-14V 12" coax speaker, $10.00 extra; 15" coax speaker, $20.00 extra.

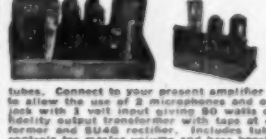
11-TUBE FM-AM HALLICRAFTERS

HALLICRAFTERS S-78A

Regular $89.50 $**69.95** LESS SPEAKER
McGEE'S SALE PRICE
★ HIGH FIDELITY
★ AUTOMATIC FREQUENCY CONTROL

Hallicrafters Model S-78A, 11 tube FM-AM superhet custom chassis. Size 7½" x 13½" x 11" deep. Complete with tubes, knobs, escutcheon, diagram and instructions. Receives broadcast 540 to 1700 kc, plus FM 88 to 108 mc. AFC holds FM stations in perfect tune. Output transformer matches 3.2 ohm or 500 ohm. High fidelity response, 50 to 14,000 cps. Bass boost tone control. A full 11 tube transformer powered chassis with push-pull 6K6 audio. This chassis found in $400 to $600 radio combinations. Mag. input for crystal phono. Self-powered preamplifier necessary for G.E. variable reluctance cartridge, $3.95 extra.

S-78A Hallicrafter 11 tube FM-AM chassis. Ship. wt. 22 lbs. Sale price.....$89.95
CU-14V, 12" COAX SPEAKER $10.00 EXTRA. 15" COAX SPEAKER $20.00 EXTRA.



50-WATT BOOSTER AMPLIFIER $39.95

2-Mike Pre-Amp $12.95 Extra. Not a Kit, but a Manufactured Amp.

A sensational value. A 50 watt booster amplifier with push-pull, parallel 6L6 output tubes. Connect to your present amplifier as a booster or use with the PB-2X pre-amplifier to allow the use of 2 microphones and one low level input. The amplifier has one input jack with 1 volt input giving 50 watts of audio. Amplifier has a 6 lb. potted case high fidelity output transformer with taps of 4-8-16-500 ohms. 225 mil power transformer and 5U4G rectifier. Includes tubes: 4—6L6, 7N7 and 5U4G. Two variable tone controls for master volume and bass boost tone control. Chassis size, 8" x 8½" x 14½". Model No. PA-50N. Ship. wt. 26 lbs. Sale price, $39.95. PB-2X, 2 mike input pre-amplifier plugs in directly to the PA50N 50 watt booster amplifier. Allows use of 2 microphones, either crystal or dynamic and one low level input. Furnished with 4 ft. connecting cable and plug for remote control of the 50 watt booster. Chassis size, 5½" x 3½" x 2½". Model PB-2X. Sale price, $12.95.

McGee's Famous 12 AND 15 INCH COAXIAL P.M. HIGH FIDELITY SPEAKERS

$12.95 12-Inch Model CU-14Y

$23.95 15-Inch Model P15-CR

Model CU-14Y, 12" high fidelity coaxial PM speaker. Response from 30 to 17,500 cps. Full 6.8 oz. Alnico V magnet in the 12" woofer. Special coaxially suspended high frequency tweeter. Built-in cross-over network. Only two wires to connect to your radio or amplifier. Matches 3.2 to 8 ohm output. Don't confuse this speaker with many cheap speakers that are offered. This is a fine quality speaker. Stock No. CU-14Y. Sale price $12.95 each, two for $25.00.

Model P15-CR 15" high fidelity coaxial PM speaker. Response down to 20 cps, and up to 17,500 cps. Full 21½ oz. Alnico V magnet in the 15" woofer. Specially made, coaxially suspended 5" high frequency tweeter. Built-in crossover network. Only two wires to connect. Matches 3.2 to 8 ohm output transformer. A regular $62.50 list speaker. Model P15-CR, McGee's Sale Price, $23.95.

WEBCOR 3 SPEED CHANGER MOD. 140-16 WITH 2 NEEDLE FLIPOVER CARTRIDGE $24.95

New Model 140-16, Webster-Chicago 3 speed automatic record changer with Astatic 56-T90Y, 2 needle flipover crystal cartridge. Plays all 3 speeds on all 3 size records. Shuts off automatically after last record. Has neutral position to prevent damaging drive wheels when changer is not in use. 13¾" x 12" wide, 7½" high overall. 3½" below motor board and 4½" above. Model 140-16. Ship. wt. 12 lbs. Sales price, $24.95.

Model 114-42 Webster-Chicago 3 speed changer with G.E. RPX-060 variable reluctance cartridge, otherwise similar to above. Sale price, $29.95.

EQ-2, self-powered preamplifier for use with a variable reluctance cartridge when your radio or amplifier only has input for crystal cartridge. Just plug V.R. pickup into pre-amp and pre-amp into regular phono input. Model EQ-2 preamplifier with tube, $5.95.

REGULAR $65.00 LIST COLLARO 3 SPEED HI-FI CHANGER

Imported from England
Sale Price **$38.95**
Less Cartridge

Regular $65.00 list Collaro Model 3/833, 3 speed automatic record changer made in England. Intermixes 10" and 12" records of the same speed. Constant speed 4 pole motor with weighted turntable with welded rubber pellet. Compensating spring to shift weight of tone arm for LP and Std. records. Plug-in head will hold any popular cartridge. 14¾" long, 12¼" wide and 4¼" above motor board, 2⅞" below. Available in grey, cream and gold hammertone finish. Ship. wt. 20 lbs. Regular net, $48.75. Special sale price, $38.95, less cartridge. Large 45 RPM spindle $2.30 extra. 3 352 Collaro changer with G.E. RPX-052A "Golden Treasure" cartridge, $58.95.

ENGLISH GARRARD CHANGERS

RC-80 WITH GE RPX052A **$68.51**

RC-80 Garrard, 3 speed automatic record changer. Shuts off after last record. Heavy 4 pole AC motor and weighted turntable gives constant speed. Muting switch silences pickup during change cycle. Separate plug-in head to fit all cartridges. 13¾" wide, 13½" deep and 8" high. 2½" below motor board. Net price, less cartridge, $48.81, with Pic-n-ever crystal cartridge, $52.46, with G.E. RPX-052A "Golden Treasure" cartridge, $68.51. 45 RPM spindle $3.43 extra.

RC-90 w. GE RPX052A **$88.11**

RC-90 Garrard "Crown" 3 speed automatic record changer. All of the features of the RC-80 plus adjustable speed control to regulate speed faster or slower on all 3 speed settings. Has manual position for playing single records. Separate plug-in heads to fit all cartridges. 13½" long, 13½" wide, 5¾" above motor board, 3⅞" below. Finished in stream and brown. Ship. wt. 19 lbs. Net price, $68.51, less cartridge, with Pic-n-ever crystal cartridge, $72.06, with G.E. RPX-052A "Golden Treasure" cartridge, $88.11. 45 RPM spindle $2.43.

8", 10", 12" SPEAKER-BAFFLE COMBINATIONS

8" - $3.95 10" - $4.95 12" - $6.95

Our most popular speaker-baffle combinations. Brown leatherette covered wood baffle and 8", 2.8 oz. Alnico V magnet speaker. Most economical wall speaker. Stock No. 818-X. Sale price, $3.95 each. Lots of 3 or more, $3.79 each.

Brown leatherette covered wood baffle and 10", 3.16 oz. Alnico V magnet speaker, at little more than the 8" size. Stock No. CA-102. Sale price, $4.95. Lots of 3 or more, $4.79 each.

Brown leatherette covered wood baffle and 12" RCA PM speaker. A terrific McGee value. Only 500 to sell. You get the baffle and speaker for the value of the speaker only. Stock No. RCA-812. Sale price, $6.95. Lots of 3 or more, $6.79 each.

McGEE RADIO COMPANY

PRICES F.O.B. KANSAS CITY
SEND 25% OR FULL REMITTANCE WITH ORDER. BAL. SENT C.O.D.

TELEPHONE VICTOR 5092
1903 McGEE ST., KANSAS CITY, MISSOURI

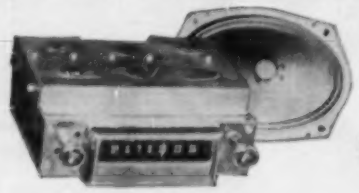
6 TUBE UNIVERSAL MOUNTING AUTO RADIO $19.99

LESS THAN FACTORY COST!

★ A SENSATIONAL AUTO RADIO VALUE AT A TERRIFIC LOW PRICE.
★ MADE BY A BIG NAME MANUFACTURER.
★ FULL SUPERHET—WITH TUNED R.F. STAGE—6 TUBES—TONE CONTROL.

McGee offers another tremendous purchase and passes the saving on to you. This universal mounting, 6 tube, 6 volt auto radio is a full superhet with fully tuned R.F. stage. Made to sell at a much higher price, by one of America's best known manufacturers. Its very thin and compact construction lends it to a neat underdash installation in most any car or truck. Or, you can arrange a place in the dash for custom installation. (Dial requires a cut-out 8½" long x 3½" high) Tone control holes are 7" centers. A minimum of 6¼" depth behind dash.) When mounted underdash it extends only 2¼" below. Overall size: 9" wide, 4½" high and 7½" deep. Requires no more room under your dash than an ordinary auto radio remote control head. Not intended for an exact custom panel fit, but it lends itself very well for your custom installation ideas. Can be custom fit in most late model cars and trucks. Has no built-in speaker, but is furnished with a heavy duty 6x9" speaker. This is the most popular size auto radio speaker. Tubes: 6BE6, 2—6BD6, 6AV6, 6AQ5 and 6X4. Ship. wt. 12 lbs. Stock No. AH-759. McGee's sale price, $19.99 for the radio complete with 6x9" speaker. 3 section top cowl antenna, $2.39 extra.

New Snyder Rear Deck Dual antenna kit $6.98 extra. Has two 3 section antennas and 18 ft. connecting cable with "High-Q" auto antenna booster. Model SD-88, Ship. wt. 4 lbs.



6-TUBE, 6-VOLT
UNIVERSAL MOUNTING
AUTO RADIO
$19.99 WITH 6" x 9" SPEAKER

AH-759—With 6 x 9 Speaker $19.99
AH-759—With 5 x 7 Speaker 19.99
AH-759—With Two 5 x 7 Speakers 22.95
RP-232X—Rear Seat Speaker Kit as Shown on Left ..... $4.49 Extra

REAR SEAT SPEAKER

KIT WITH 6 x 9" UTAH PM CHROME GRILL 3-WAY SWITCH & CABLE $4.95

Genuine Utah heavy duty 6x9" PM auto radio speaker with chrome grill and screen, 3-way switch, cable and instructions. Switch mounts easily under dash to permit playing either front, rear or both speakers simultaneously. Speaker has heavy Alnico V magnet; gives excellent tone. Stock No. RP-232X, Rear Seat Speaker kit. Ship. wt. 4 lbs. Sale price, $4.95 complete.

NEW—SMALL VOLT-OHM METER

2000 OHMS PER VOLT
AC-DC
WITH TEST LEADS

McGEE SCOOP SALE PRICE $9.95

2 FOR $19.50—4 FOR $37.00

New, small Volt-Ohm meter 5¼" tall, 3½" wide and 1½" thick. 3¼" meter. Sensitivity 2000 ohms per volt. DC volts 0 to 1000 in 5 ranges; AC volts 0 to 1000 in 5 ranges; DC current 0 to 500 ma. in 3 ranges; Resistance 2 ohms to 1.5 megohms in 2 ranges; Decibels minus 20 to plus 16 (Ods .774 volts). A thin, compact instrument small enough to fit in the pocket, at the imported meter specialty price at $9.95 for this Radio & TV News ad. Never before have we offered an instrument value like this. Model TP-5, complete with test leads. Sale price, only $9.95. Ship. wt. 2 lbs. Special quantity price, 2 for $19.50, or buy 4 for only $37.00.

New, larger size Volt-ohm meter Model MT-1A, 6¼" tall, 4¼" wide and 2½" thick. 3000 ohms per volt. Similar in appearance to Model TP-5, except that it is larger, has 3½" meter and 4 resistance ranges instead of 3. Model MT-1A. Ship. wt. 2 lbs. Sale price, $12.95 each, 2 for $25.00.

$100.00 LIST—12 VOLT BUICK AUTO RADIO $39.95

Fits All '53 Models Except Special

No. 981333. 8 tube 12 volt Buick radio. Custom made for all '53 Buicks except the Special. Cost over $100 retail. Magic Selectronic single push-button tunes set electronically. Built-in 8" speaker, tone control, PP 12V6 audio. Ship. wt. 35 lbs. Sale price, $39.95.

6" SESSIONS CLOCK-TIMER

With Plastic Cabinet $3.95

6" Sessions Clock-Timer in plastic case 7" x 9½" tall, 3" deep. Was intended for a kitchen clock radio. Lower part of case was used for a small radio chassis. Lower portion has a usable space of 6¼" x 4" high and 3½" deep with 3" diameter hole in front. Many ways this attractive clock and cabinet could be used, such as mounting a small bell below the clock for use as a kitchen clock and timer. Clock has sweep second hand and 15 amp. 125 volt switch to turn on appliances at any pre-set time. Case available in Ivory, Green or Yellow. Stock No. MCT-63, Sessions Clock Timer with case of your color choice. Sale price only $3.95.

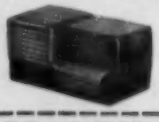
MINIATURE BROADCASTING STATION

AN EDUCATIONAL CHRISTMAS GIFT!
SALE PRICE $9.95
With CRYSTAL MIKE

Sensational new model MCL-E3 miniature broadcasting station for microphone and phonograph. Can be received on any broadcast radio in the home. No wires to connect, tunes in just like a radio station. Has input jacks for crystal mike or record player. Complete with 12AU6 and 70L7 tubes and instructions. Operates on 110 volts AC. Simple to operate; one control feeds from microphone to record. Frequency can be adjusted so as not to interfere with local radio stations. Miniature broadcasting station, complete with crystal hand mike and instructions. Ship. wt. 4 lbs. Net price $9.95.

6-TUBE, 2-BAND RADIO KIT $14.95

6-18 MC 550-1650 KC



6 tube, 2 band AC-DC radio kit, complete with speaker and plastic cabinet. Popular with schools and colleges for training in radio. Receives broadcast and 6-18 mc shortwave. Full 2 gang superhet with 5" speaker and slide rule dial. A complete kit with tubes: 12K8, 2—12SK7, 12SQ7, 50L6 and 35Z5. diagram and instructions. Cabinet 13" x 6¾" x 6¼". Ship. wt. 12 lbs. Model MRK-9, Net $14.95.

$59.95 TIMEX MAGNETIC RECORDER

SPECIAL SALE PRICE $29.95
CRYSTAL PICKUP TO PLAY PHONO RECORDS $2.95 EXTRA

SALE PRICE $29.95
MODEL 40 TIMEX

RECORDS AND PLAYS BACK PLAYS 16⅔ AND 45 RPM RECORDS

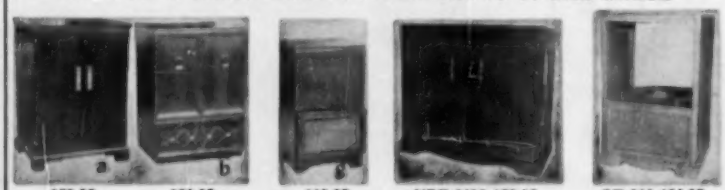
A product of United States Time Corp. (Timex) A multiple purpose machine made to retail for $59.95. McGee buys a solid carload and you save by buying now at only $29.95, plus $2.95 for a 45 RPM record adaptor and crystal head for 16⅔ or 45 RPM phono records. Records and plays back for 3½ minutes on a wafer thin flexible magnetic disc. Make recordings of your family—use for office dictation—dictate records that may be mailed without breaking. Attractive brown plastic case, 9½"x11½"x4½". Turntable speeds 16⅔ and 45 RPM. Response 100 to 4000 cps. Amplifier has neon level indicator, volume control and selector knob with playback, record and phono positions. Uses 12AX7, 50C5, 6C4 and 35W4 tubes. Built-in 4" speaker. Complete with Shure variable reluctance microphone. Provides faithful reproduction at low volume of voice or music, recorded through the microphone supplied or direct from your radio or TV. As simple to operate as a record player. Stock No. TIM-81 recorder, ship. wt. 13 lbs. Sale price, $29.95.

Recording discs, package of 6 for 99¢. One blank shipped with recorder.

You may purchase a plug-in crystal phono pickup to adapt this recorder for playing 16⅔ or 45 RPM phono records for only $2.95 extra.

TELEVISION CONSOLE CABINETS AT LESS THAN FACTORY COST!

FOR YOUR TV CHASSIS—MODELS FOR 27 INCH TO 16 INCH CHASSIS



$59.95 $59.95 $19.95 NRT-21M $59.95 BT-210 $22.95

27" Mahogany Full Door Cab. $59.95

(a) No. 27-MA. Mahogany with full doors for 21", 24" and 27" TV. 43" h. 30½" w. 23" deep. Chassis area 27½" w. 25" h. 18½" deep. Baffle for 10" speaker. A beautiful cabinet that cost the factory over $100. Made for a $600 TV set. Ship. wt. 90 lbs. Sale price $59.95. Blank panel $5.00 extra. Shipped with mask and safety glass.

27" ¾ Door Mahogany Cab. $59.95

(b) No. 27-34MA. Mahogany with ¾ doors for 21", 24" and 27" sets. 43" h. 31¼" w. 23¾" deep. Chassis area 27½" w. 24½" h. 21" deep. Baffle cut for 10" speakers. Made for one of America's largest TV builders. Cost over $100. Ship. wt. 90 lbs. Sale price $59.95. Blank panel $5.00 extra. Shipped with mask and safety glass.

17" with PHONO DRAWER $19.95

Fig. (c) SE-21, 17" mahogany TV cabinet with phono drawer 40" h., 24" w., 18½" deep. Blank panel. TV chassis area 15" h., 20½" w. Changer drawer 19¼" wide, 13" deep. Baffle cut for 10" speaker. Ship. wt. 75 lbs. Sale price $19.95.

DELUXE 21" MAHOGANY TV-PHONO CABINET

No. NRT-21M. Deluxe piano finish mahogany combination radio-phono-TV cabinet for 20" or 21" TV chassis. Beautiful full door style with matching front panels. 37" high, 40½" wide and 22½" deep. Baffle cut for a 12" speaker. TV chassis area 21" high, 23½" wide and 19" deep. Changer shelf 13" x 17" with 9" height clearance. Ship. wt. 165 lbs. No. NRT-21M, mahogany cabinet, sale price, $59.95. 21" mask and safety glass, $6.95 extra.

21" BLONDE $22.95—MAHOGANY OR WALNUT $19.95

No. BT-210, blonde cut 21" TV cabinet. 27½" high, 24" wide and 20½" deep. TV chassis area 20½" high, 23½" wide and 18½" deep. Baffle cut for 10" speaker. Open front, no blank panel furnished. Shipping weight 65 lbs. Sale price, $22.95.
No. WT-210, walnut 21" TV cabinet, same as above. Sale price, $19.95.
No. MT-210, mahogany 21" TV cabinet, same as above. Sale price, $19.95.

McGEE RADIO COMPANY

PRICES F.O.B. KANSAS CITY
SEND 25% OR FULL REMITTANCE WITH ORDER. BAL. SENT C.O.D.

TELEPHONE VICTOR 5092
1903 McGEE ST., KANSAS CITY, MISSOURI

AMERICA'S FINEST VALUES IN "LOW COST" HIGH FIDELITY

ECONOMY 20 WATT AMPLIFIER $22.95

NEW 1956 MODEL

Push-Pull 6L6 Output Tubes
Response 30—15,000 CPS
Bass and Treble Tone Controls
Input for Xtal or Dynamic Mike
Input for Xtal or V.R. Phono

With CU-14Y, 12" Coax Speaker . . . $32.95
With P15-CR, 15" Coax Speaker . . . $42.95
With Imperial IV System $39.95
With SP-12125CR $44.95
With HF-33GE $69.95

A tremendous High Fidelity amplifier value. Response 30 to 15,000 cps. Electronic bass and treble boost by separate tone controls. Use this amplifier with any record changer having crystal or variable reluctance cartridge, radio tuner or high impedance crystal or dynamic microphone. 20 watts undistorted output. Use with any 4 or 8 ohm speaker or 250 ohm line. Chassis size, 7¾" x 10½" x 7¼" high. Complete with tubes: 2—6L6, 2—6C4, 12AX7 and 5U4G. This is a terrific value. A ready to use high fidelity amplifier at less than the cost of a kit. Ship. wt. 17 lbs. Model HF-20, 20 watt Hi-Fi amplifier, McGee's sale price, $22.95.

CONSOLE HI-FI SPEAKER SYSTEM $49.95

12" G.E. PM WOOFER—10" PM MID-RANGE—8" G.E. MODEL 850 MID-HIGH RANGE SPEAKER AND 600 CYCLE L-C CROSSOVER NETWORK.

Have Juke Box tone quality in your own home. Strictly High fidelity. Three speakers all connected to a 600 cycle frequency dividing network, so that only 2 wires from the system from any 4 or 8 ohm radio or amplifier. A variable tone compensating control incorporated in the circuit makes brilliant highs or boomy lows to your own taste. Any amplifier that you now have will give you a much wider selection of acoustical arrangements with this speaker system. The 3-way system is shipped ready to connect to your amplifier or hi-fi radio. Equipped with a General Electric 12" woofer, an 8" famous G.E. 850 plus a 10" middle range speaker. Frequency response 30 to 15,000 cps. Take your choice of cabinets: blonde oak, walnut or mahogany. (Specify finish desired when ordering) 37" high, 24" wide and 20" deep. Ship. wt. 75 lbs. Stock No. HF-33GE. Sale price, $69.95.

Model HF-44GE, console speaker system, same as above except has a heavy duty 12" G.E. PM Model 1201, plus 8" G.E. PM Model 850, 10" mid-range speaker and 5" hard cone tweeter. Sale price, $54.95. (Specify cabinet finish.)

Model HF-55GE, super deluxe quality console speaker system, same as HF-33GE described above, except has 15", 31 oz. Alnico V magnet woofer, 10" mid-range PM speaker and Model 4401 University horn type tweeter. All 3 systems incorporate 600 cycle L-C type crossover network with variable tone compensating control. Model HF-55GE, Sale price $69.95 (specify cabinet finish).

DELUXE CONSOLE SPEAKER SYSTEM $89.50

15" UTAH WOOFER—8" GE—2 - 5" TWEETERS—CROSSOVER

New, deluxe quality High-Fidelity console speaker system. Has 15" Utah woofer with 21 oz. Alnico V magnet, 8" model 850 G.E. mid-range speaker and two Utah 5" tweeters. Theile type enclosure that we offer. Available in blond oak or natural mahogany finish. Cabinet size, 43" high, 31" wide and 23" deep. Has ¾" length doors with attractive hardware and ornament on grill below doors. All 4 speakers covered. A 600 cycle frequency dividing network, so that there are only 2 wires to connect to any 4 or 8 ohm output of your radio or amplifier. Has variable tone compensating control built-in. Model HF-15CR4, deluxe quality Hi-Fi console speaker system. Ship. wt. 100 lbs. (Specify cabinet finish desired.) Sale price, $89.50.

NEW IMPERIAL IV with General Electric 8 in. HIGH FIDELITY SPEAKER $19.95

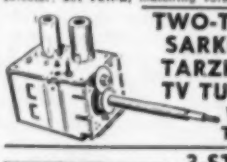
New 1955 Model IMPERIAL IV, High Fidelity speaker system with General Electric 8" speaker. Housed in a high quality leatherette covered plywood cabinet 10" x 10" x 24" long. Fully sides and covered on all sides except back. Use as an auxiliary speaker or with any high fidelity radio, amplifier or home music system. The IMPERIAL IV contains a General Electric Model 850 extended range high fidelity 8" PM speaker with 6.8 oz. Alnico V magnet and 8 ohm voice coil and a 5" tweeter. Response 50 to 15,000 cps. Model IV Imperial $19.95. Ideal for use with HF-20 and IMP-30 amplifiers described above.

FAMOUS STANDARD COIL CASCODE TUNERS

TV-2000 series Standard Coil cascode tuners complete with 6J6 and 6BK7 or 6BQ7 tubes. Thousands of TV sets use this famous tuner. Tunes 12 channels (2 thru 13). For 21 mc I.F. circuit. This tuner will give 2 to 1 better reception than the old pentode type. Many servicemen replace all older tuners with this cascode model. Available with either 27½" or 41½" shaft length. A tremendous purchase makes our low $12.95 price possible. Specify shaft length desired. Stock No. TV-2000-3. Sale price $12.95 each, 2 for $25.00.

Matching knobs for Standard Coil tuners. Set No. SCK-2 for fine tuning and channel selector. Set VCR-2, matching volume and contrast knobs. Either set only 89¢ a pair.

SALE PRICE $12.95
2 FOR $25.00



TWO-TUBE SARKES-TARZIAN TV TUNER WITH TUBES

$7.95 EA., 2 FOR $15.00

No. TT-3A, 2 tube Sarkes-Tarzian 12 channel TV tuner. 21-25 mc. Popular in many makes. Ideal for general replacement use too. Has 6J6 and 6BC5 tubes. Used in CBS, Arvin, Crosley, etc. Makes a good replacement for one tube tuners. ⅜" shaft. Takes SCR-2 knob set described above. Sale price, $7.95 each, 2 for $15.00 with tubes.

3-STATION MASTER SUB-STATIONS $3.95 EACH $16.95

Powerful 3 station master. Chrome plated metal case 7½" x 6" x 5". 3 tube AC-DC amp. Press-to-talk switch on top. Volume control, switch and station selector on side. Master is quiet except when call switch is pressed at sub. Use with one to 3 subs. Model MFM-A3, ship. wt. 10 lbs., $16.95. Matching sub-station FM-A3, with 6" PM and call-back switch, $3.95 ea.; 3 for $10.00. Requires 3 wire intercom cable, $3.95 per 100 ft.; 500 ft. for $8.95.

TELEVISION BOOSTER CLEARANCE SALE

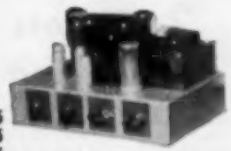
Clearance sale on VHF television boosters for channels 2 through 13. RMS Model SP-S, metal case, brown wrinkle finish. Continuously variable tuning, 6AK5 tube. Ideal for late model sets with cascode front end. Sale price $4.95

RMS Model SP-G, brown plastic case. Same as SP-S except has variable gain control. (Pictured.) Sale price $4.95

McMurdo-Silver GB-68 continuously variable, includes FM band. 6J6 tube, brown plastic case. Sale price $5.95

Standard Coil B-51 printed circuit booster. 6AK5 tube, brown plastic case. Sale price $6.95

IMPERIAL 30 WATT AMPLIFIER $29.95



NEW 1956 MODEL

Push-Pull 6L6 Output Tubes
Response 15-20,000 CPS
Bass and Treble Tone Controls
Compensated Gain for G.E. Cart.
Input for Xtal or Dynamic Mike

With CU-14Y, 12" Coax Speaker . $39.95
With P15-CR, 15" Coax Speaker . . $49.95
With Imperial IV Speaker System . $46.95
With SP12125CR $51.95
With HF-33GE $76.95

New 1956 model 7 tube Imperial 30 watt High Fidelity audio amplifier. A $100.00 list value for only $29.95. Features a heavy 6 lb., specially wound high fidelity output transformer with 15% inverse feedback; push-pull 6L6 output tubes and frequency response from 15 to 20,000 cps. Matches 8 or 16 ohm speakers. You can center your entire custom music system around this low cost 30 watt amplifier. This Imperial 30, 30 watt amplifier may be used with any radio tuner or record player. It will drive any speaker system that you may have. Use from one to ten 6" speakers or any 12" or 15" coaxial speaker or any 3-way speaker system. Tone compensated input for either a crystal phono pickup or a General Electric variable reluctance pickup. Also, has input for crystal or high impedance dynamic microphone. 4 controls are mike gain, phono gain, treble tone and bass boost tone control. This amplifier weighs 21 lbs. net. Full size transformer components used. Value up to $15.00 if purchased separately. Gold color chassis is 12½" x 7½" x 7¼" high. Complete with tubes: 6AT6, 6AU6, 6C4, 12AL7, 2—6L6GA, plus 5U4G rectifier. Stock No. IMP-30, 30 watt Imperial Hi-Fidelity amplifier complete with tubes and diagram. Ship. wt. 23 lbs., Sale price only $29.95.

25 WATT HI-FI SPEAKER SYSTEM

2-12" Woofers
2-5" Tweeters
Power Supply and L-C Cross-over Network

SALE PRICE $24.95

25 watt, High-Fidelity Dynamic Speaker System, complete with 2000 cycle genuine inductance-capacitance cross-over network, two 12" woofer speakers, two 5" high frequency tweeter speakers and separate 110 volt AC power supply for only $24.95. Frequency response 30 to 18,000 cps. Both the woofers and the tweeters are fine quality dynamic speakers with fields excited to saturation by the power supply. Tweeters are specially made with cones designed to respond only to the high frequencies of the audio spectrum. The 2000 cycle cross-over network is of the high quality inductance-capacitance type which prevents frequencies below 2000 cps from entering the tweeters and eliminates frequencies above 2000 cps from the woofer circuit. The complete system is simple to connect to any 4 or 8 ohm output of your high fidelity audio amplifier or radio. No. SP-12125CR, High Fidelity Dynamic Speaker System. Ship. wt. 15 lbs. Sale price, $24.95.

No. SPS-12125, High Fidelity Dynamic Speaker System, as described above, but less the 2000 cycle cross-over network and with a separate attenuator control. Sale price, $14.98. Ideal for use with HF-20 and IMP-30 amplifiers described above.

HIGH FIDELITY SPEAKERS

8" BLUE STREAK TWEETER . . . . . $ 2.95
8" BLUE STREAK . . . . . $ 6.95
15" BLUE STREAK WOOFER $16.95

Model HF-8J, 8" "Blue Streak," High Fidelity wide range speaker. This one speaker properly baffled will give excellent response to both high and low frequencies and terrific response through the very important middle range. Has 6.8 oz. Alnico V magnet with wide range curvelinear cone and 8 ohm voice coil. Response essentially flat from 32 to 12,000 cps. Perfect for high fidelity radios, amplifiers and professional music systems. Ship. wt. 6 lbs. Model HF-8J. Sale price, $6.95.

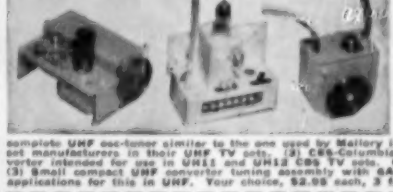
Model HF-15WF, new 15" "Blue Streak" HiFi woofer. Has 21½ oz. Alnico V magnet with one piece cone and 15 ohm voice coil. Will give excellent response from 50 to 9500 cps. Takes 15 to 25 watt peak. Ship. wt. 12 lbs. Sale price, $16.95.

PHILCO SPEAKER SALE!

GENUINE PHILCO FIELD COIL DYNAMIC SPEAKERS. 2.2 OHM VOICE COIL. INDIVIDUALLY CARTONED. BUY AT LESS THAN FACTORY COST.

8" 1700 or 2500 Ohm Speaker . . . $1.29
10" 1700 or 2500 Ohm Speaker . . . 1.49
12" 2500 Ohm Speaker . . . $1.99

BUY 12 ASSORTED AND WE WILL SHIP A BAKER'S DOZEN (13 SPEAKERS FOR THE PRICE OF 12).



UHF CONVERTER TUNERS $2.95 3 FOR $7.50

Take your choice of any of these three UHF converter-tuners at $2.95 each, 3 for $7.50. (1) Mallory indoctor-tuner with 6AF4 and 1N72 diodes. This is a complete UHF osc-tuner similar to the one used by Mallory in a converter and by many set manufacturers in their UHF TV sets. (2) CBS-Columbia single channel UHF converter intended for use in UHF and UHF/VHF CBS TV sets. Complete with 6AF4 tube. (3) Small compact UHF converter tuning assembly with 6AF4 tube and diode. Many applications for this in UHF. Your choice, $2.95 each, 3 for $7.50.

AIR KING FM-AM TUNER SELF POWERED

Use with any Audio Amplifier

SALE PRICE $24.99

Air King factory built, 6 tube self-powered FM-AM radio tuner. Receives broadcast 540 to 1620 kc and FM 88 to 108 mc. Use with any Hi-Fi audio amplifier or connect it to your TV set for FM-AM reception. Selector switch has 4 positions for TV-Phono, FM and AM. 3 other controls are volume-off-on, tone and tuning. With tubes: 12AT7, 2—6AU6, 6AL5, 6SQ7, and 5Y3 rectifier. Chassis size, 11½" x 7½" x 6¼" high. Illuminated slide rule dial 9½" x 3½". Select-a-tube circuit knobs. Self-powered with its own power transformer. Air King FM-AM tuner chassis No. 703 as used in Air King model 17K1C combination TV-Radio-Phono with power supply added. Note: A separate audio amplifier is required to operate a speaker. Stock No. AIR-K6, self-powered FM-AM tuner, complete with tubes, knobs and diagram. Ship. wt. 10 lbs. Sale price, $24.99.

McGEE RADIO COMPANY

PRICES F.O.B. KANSAS CITY
SEND 25% OR FULL REMITTANCE WITH ORDER. BAL. SENT C.O.D.

TELEPHONE VICTOR 5092
1903 McGEE ST., KANSAS CITY, MISSOURI

Problem:

2 TV Sets
1 Antenna

Answer:

B-T LABS

2-SET COUPLER

Model TV-42
Approved for Color TV
UHF, VHF and FM

Cost: ONLY $2.95 LIST

Features:

- Matched resistive circuit
- Flat response—0 to 900 megacycles
- 12db inter-set isolation
- Easy to install
- Couples 2 TV sets without ghost or smear

Application:

In close A signal areas the B-T 2-Set Coupler provides the ideal low cost solution to the problem of operating two receivers from one antenna. There are other applications. For example, the TV-42 can couple a TV set and FM receiver to one antenna—or it can be used, in reverse, to couple or mix 2 antennas to one receiver.

Write for FREE BOOKLET—"TV for 2 or 3 . . . or More"
Covers all types of Multiple TV Systems

Sold by Radio-TV Parts Distributors and Jobbers

BLONDER-TONGUE LABORATORIES, INC.
Dept. LM-4 Westfield, New Jersey

B-T LABS

Manufacturers of TV Cameras, TV Amplifiers, Boosters, UHF Converters, TV Accessories and Originators of the Masterline and 'Add-A-Unit' Master TV Systems.

Hi-Fi-Audio Equipment

(*Continued from page* 113)

on or removed from the record. In addition, the arm offers positive placement of the stylus, decreased record wear, indexing by means of a calibrated

scale on the arm housing, counterbalancing, rapid cartridge changing where required, and easy installation.

"CABINART" ACCESSORIES

G & H Wood Products Co., Inc., 99 North 11th St., Brooklyn 11, New York, is now offering a line of audio accessories to the trade.

Among the items currently available are record changer bases for five *Garrard* changers and turntables and three *Collaro* changers and players. These bases are precut and are available in blonde or dark finishes.

TAPE RECORDER ATTACHMENT

RCA Victor is now offering a new tape recorder attachment designed to serve as an accessory to the "Mark II" and "Mark III" units in the firm's "New Orthophonic" phonograph line.

The attachment has its own mahogany cabinet styled along the lines of the instruments with which it is to be used. The recorder itself is a duplicate of the recorder in the "Mark I" twin-cabinet. It features 2-speed operation (3.75 and 7.5 ips), record level tuning

eye, 2-speed equalization control, and erase indicator. Recording of AM and FM radio programs is possible as well as direct recording.

UNIVERSITY SPEAKER SYSTEM

University Loudspeakers, Inc., 80 S. Kensico Ave., White Plains, New York is now offering a new line of speaker systems which has been tradenamed "Decor-Coustic."

The top of the line is the "Master," a three-way speaker system which provides peak performance whether placed flat against the wall, in the corner, or even in the center of the room. The special acoustic design is a combination of the best features of horn loading, phase inversion, and direct radiation. The speaker and network components used in this system are the company's C15W dual-impedance woofer, the 4409 "reciprocating flares" horn speaker for mid-range, and the HF-206 super-tweeter for high-frequency coverage.

The three-way system is available in

cherry and blonde mahogany cabinets which measure 37" x 28" x 19¼".

"PLUS 100" TAPE

Reeves Soundcraft Corporation, 10 E. 52nd Street, New York 22, N. Y., has developed an ultra-thin recording tape which permits a mile of the medium to be wound on a single 10½ inch reel.

Using the new "Mylar" polyester film as a base, the "Plus 100" tape is only ½ mil thick. This "mile of tape" will run continuously for nearly nineteen hours at 1⅞ ips on a double-track machine. The new tape is also available on a 7" reel (2400 feet) and a 5" reel (1200 feet). The 7" reel provides as much as 5 hours of continuous recording at a speed of 7½ ips on a double-track machine.

PICKERING "FLUXVALVE"

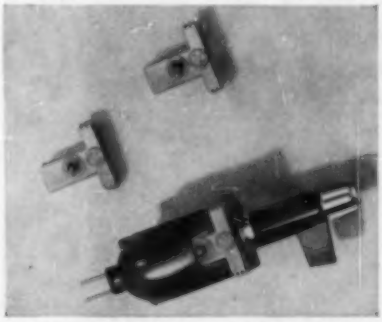
Pickering & Company, Inc. of Oceanside, New York has developed a radically new wide-range magnetic pickup with easily replaceable styli which is being marketed as the "Fluxvalve."

The design of the cartridge is such that it meets the demands of all presently envisioned recording developments, including those utilizing less than 1 mil styli.

The "Fluxvalve" is a turnover design featuring easily replaceable styli. A new kind of stylus offers extremely high compliance for a tracking force of from 2 to 5 grams. The vibratory mass has been reduced to an amount so low that pickup response is flat at 30 kc. on ordinary vinyl.

Electrical characteristics include an absolutely flat frequency response to well beyond 20 kc.; negligible IM distortion; output of 25 millivolts at a normal recording level; and medium impedance, requiring a termination of 47,000 ohms.

The pickup is supplied with a mounting clip which adapts it to all standard



arms and also acts as a bearing for the turnover action.

KLIPSCH "SHORTHORN"

Klipsch and Associates of Hope, Ark. has announced that its "Shorthorn" loudspeaker system, formerly available only in kit form, is now being marketed assembled and finished.

The exposed wooden parts are made of either dark mahogany or light "primavera". The unit may be purchased with a 15" or 12" three-way system or without a drive system. An unfinished utility model is also available for those who wish to match the enclosure to some special color scheme.

–30–

TRANSISTORS NOW 99 CENTS!

GOOD news for hobbyists and experimenters is contained in the recent word from Raytheon announcing another price reduction in its CK722 transistors. The new price is 99 cents!

To those who recall the early production runs of these components and the $7.60 price tag in 1952, the new price will seem a veritable miracle. At the time the first transistors were placed on the market in commercial quantities, predictions were that in ten years or so when the price of transistors had been sufficiently reduced to compete with vacuum tubes that the day of the transistor would dawn.

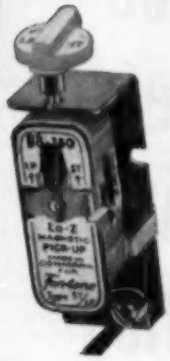
That the "new era" has arrived well betimes is due, entirely, to the technical "know how" of the manufacturers and the vast improvement in production techniques.

Probably more startling than the price reduction is the fact that this reduction has been accompanied by a steady improvement in the product itself. For example, the current gain of the first CK722's was 12 while today it is 22. Reliability of these components has reached the stage where it is taken for granted rather than serving as a cause for delighted amazement.

At the present time, Raytheon is offering fifteen types of transistors for audio, low-noise audio, and r.f. applications. All of the units in this line are of the fused-junction "p-n-p" type and are packaged in both hermetically sealed and plastic non-hermetically sealed cases.

The company is also marketing a series of extra-small-sized transistors such as the 2N130 which has characteristics similar to the CK722 but is only one-quarter to one-third the size. Other units in the same series are the 2N131, 2N132, and 2N133. –30–

Meet the only cartridge with fan-mail! The new professional Fen-Tone B&O-350 8-pole low-Z magnetic cartridge is acclaimed everywhere.



Robert V. B., M.D. Montpelier, Ohio, writes:
"I am a very critical person....When I said I would give your cartridge a real test, I meant it....My decision after giving it "the works"....IT IS PHENOMENAL! I don't go overboard—but I have, haven't I? Well there are occasionally "firsts"—and you have one."

Martin L. Borish, Monmouth Music House, Freehold, N. J.:
"Our technicians still can't figure out how it can be so cheap and work so well. We rate it above any magnetic cartridge....One of the more unusual aspects of this cartridge, in addition to its exceptionally high output, is the remarkable results obtainable on 78's. Most magnetics do not work too well on the old records."

Jack B., Benton Harbor, Michigan:
"Tonite I got my Fentone cartridge into a tone arm and put it to work. I wish here and now to state that this cartridge is the ultimate in fine reproduction. I have never heard highs as free from distortion in my life. They are absolutely magnificent. I will recommend it to everyone I know as being THE cartridge."

Paul H. Little (Columnist), Chicago, Ill.:
"This cartridge is one of the finest and cleanest we have ever heard....A real contribution to wide-range undistorted listening."

Roy F. Allison, High-Fidelity Magazine:
"The price of the Fen-Tone B&O cartridge puts them in the REAL BARGAIN category."

And for broadcast—quality cartridges, they are truly a bargain!

	Audiophile Net
B&O Reversible, Silver Label (2 sapphire jewels)	$ 7.98
B&O Reversible, Gold Label (1 diamond, 1 sapphire)	19.98
B&O Single, Silver Label (1 sapphire jewel)	7.50
B&O Single, Gold Label (1 diamond jewel)	19.50

AND NOW FOR ABSOLUTE HIGH-FIDELITY

The B&O scientists bring you the professional Fen-Tone B&O-350 A+, the first and only anti-static cartridge. (Pat. Pend.)

The alpha rays, enclosed in the cartridge within a gold-silver laminate, sweep your precious records in front of your stylus, repelling dust particles from the grooves. Gone forever are the crackling noises caused by dust particles....a B&O-350 A+ prolongs the life of your stylus and records many-fold.

For the A+ cartridge, add $1.80 to above B&O-350 cartridge prices.

Literature on request. Sold through better Audio Distributors.

FENTON COMPANY 15 MOORE STREET NEW YORK 4, N. Y.

RIGHT!

IT'S THE REMARKABLE NEW

TURNTABLE

by

FAIRCHILD

...Naturally

Coming Next Month!

For *Pre-Release* Information, Mail This Coupon Today!

Fairchild Recording Equipment Co.
8th Avenue & 154th Street
Whitestone 57, N. Y.
YES, please rush me advance data on the New Fairchild Turntable!

Name.....

Address.....

City.....Zone.....State.....

NOW... PLAY the NEW PRE-RECORDED TAPES WITH FULL FREQUENCY RANGE

HIGH FIDELITY **DYNAMU** CONVERSION KITS

20-15,000 CYCLES at 7.5"!

INCREASED FIDELITY & FREQUENCY RANGE

REDUCED HUM and DISTORTION

At last, exciting new High Fidelity performance from home type tape mechanisms... record and playback HEADS need no longer be a limiting factor in frequency response and fidelity.

DYNAMU's superb new precision and quality will deliver previously unobtainable response to the input of your amplifier... 20 to 15,000 cycles at 7.5"! Play the new pre-recorded tapes with full frequency range!

DYNAMU Conversion Kits contain all components to convert your recorder. Complete illustrated step-by-step instructions are included for installation and electrical changes.

CONVERSION KITS FOR LEADING RECORDERS AVAILABLE...

SEE them, HEAR them, NOW...

Ask your Hi Fi Dealer.

DYNAMU MAGNETRONICS CORPORATION

A Division of The Maico Co., Inc.

Maico Bldg., Minneapolis, Minn.

Of this
you can be sure...

there is no finer

Record
Changer
than the

Collaro

RC-54

Automatic Intermix

+ Supplied with pre-cut Mounting Board, Power Cord and Audio Cable.

+ Automatically Intermixes All Size Records without Presetting.

+ Rapid, 7-second Change-over Cycles . . . and other outstanding features.

You can SEE it at your Sound Dealer.
You can READ about it in our Folder.

Mail This Coupon Today

ROCKBAR CORPORATION, Dept. WM-4
215 East 37th St., New York 16, N. Y.

Please send Literature describing the Collaro RC-54 Record Changer.

NAME _____

ADDRESS _____

CITY _____ ZONE ___ STATE _____

EACH JOB A COMPLETE ONE-MAN OPERATION

By GORDON CHAMBERS

Each technician has his own bench such as the one shown here, which he can set up so that he can work most efficiently.

Here's a successful service operation that makes no distinction between inside and outside technicians.

WALLACE WALKER, the owner of *Bell Television Service* in San Pedro, California, made his first income building small radios for other boys. He was literally raised on electronics. He had tubes and transformers for toys.

Service twenty-four hours a day is a reality with his service company. Service station operators, for example, listening to a radio broadcast by a favorite disc jockey at three in the morning, have no hesitation in phoning *Bell Television* should their sets stop playing, because they know the repair job will be done immediately.

Prices are not unreasonable; in fact, they are lower than those of most competitors, for the same work. The key is saving time by hiring the best technicians. The firm's policy is to hire good men, capable of doing nearly any job in or out of the shop. This enables them to cope with any problem they meet. The man going out on the job performs it completely—rather than having it performed by a group of specialists, a situation prevailing in most big service shops.

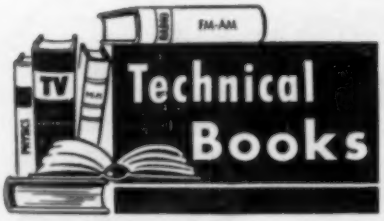
There are exceptions to this, since some men are better all-around technicians than others. Such a man usually gets the more difficult jobs, and if a man gets stuck another assists and then hands the job back to him. The man who starts the job finishes it. In this way, the customer isn't confused by talking with several technicians and getting many versions of the same story. This summing up is described in detail on the bill.

The bill describes the work done in language intelligible to a layman. Three copies are made of each bill; the third copy is in the form of a card and remains in the shop, so the technician may refer to it readily for the history of past services. The back of this copy forms the work card from which the typist makes the bill. Such a method insures the customer of getting a bill he can read.

One of the things making for pleasant working conditions and a happy state of mind on the part of all the technicians employed is that everyone is able to get out of the shop to meet people and break up the monotony of being inside the shop all the time. The net result is that the organization stays much happier. Also, each technician has his own workbench where he has privacy and may arrange his test equipment any way he desires for maximum servicing efficiency. Since each man is responsible for a set of test instruments, they are always kept in good repair. —30—

The card shown here is delivered to the customer when his repaired set is returned to him, or when the set is sold to him by a cooperating dealer. This assures repeat customers.

This instrument has been registered with our service department . . .
IN CASE OF TROUBLE CALL
TErminal 3-1407
PLEASE DO NOT CALL YOUR SALESMAN



"RADIO OPERATING QUESTIONS AND ANSWERS" by J. H. Hornung & Alexander A. McKenzie. Published by *McGraw-Hill Book Company, Inc.*, New York. 554 pages. Price $4.50.

This is a new, completely-revised Twelfth Edition of a book which has long been considered the "bible" by those preparing for FCC licensing examinations.

The book answers more than 1900 questions covering such topics as ship radiotelephone, commercial broadcasting, FM, monochrome and color TV, radiotelephone and radiotelegraph communication, broadcasting law, transistors, waveguides, and reduction of noise.

The appendices include such valuable data as the "Q-Codes," time signal information, word lists, and resistor and capacitor color codes.

* * *

"THE MOBILE MANUAL FOR RADIO AMATEURS" by the ARRL Staff. Published by the *American Radio Relay League*, West Hartford, Conn. 311 pages plus catalogue section. Price $2.50. Paper bound.

This book is a compilation of some 80 articles on mobile radio which appeared in *"QST."* The material has been presented in such a way that the newcomer to the mobile field can use the text as a guidebook to mobile techniques, or as a reference to the solution of specific problems which arise in this type of transmission.

Some 30 different mobile transmitters are described in detail along with sections on mobile antennas and power supplies, receiving techniques, and automotive noise suppression. Excerpts from the relevant FCC regulations are also included.

* * *

"ELEMENTS OF PHYSICS" by George Shortley & Dudley Williams. Second edition, published by *Prentice-Hall, Inc.*, New York. 880 pages. Price $10.60.

Completely rewritten to take advantage of the constructive criticism and suggestions received on the first edition, this volume is intended for use in an introductory course for the student of science or engineering who is taking a concurrent course in calculus. The primary objective is to provide the student with a working knowledge of the fundamental principles that describe all physical phenomena, of how they evolved, and of their scope and limitations.

The book is divided into six parts, titled Mechanics, Heat, Wave Motion and Sound, Light, Electricity and Magnetism, and Modern Physics. A plentiful supply of problems, complete with answers, appears at the end of each chapter. An appendix is included which contains many useful charts, tables, conversion factors, and the like.

* * *

"ELECTRONIC AND RADIO ENGINEERING" by F. E. Terman. Published by *McGraw-Hill Book Company, Inc.*, New York. 1087 pages. Price $12.50.

This volume represents a new and thoroughly revised edition of one of the classic texts of the electronics and radio industry—Terman's "Radio Engineering". The new title reflects an increased emphasis on the general techniques of electronics, as well as complete coverage of all important engineering aspects of electronics.

The objective is to provide a text and reference book that summarizes in easily understandable terms those principles and techniques which are the basic tools of the electronic and radio engineer. This objective has been admirably met.

The book has been divided into three major sections: Circuit Elements and Circuit Theory, Electronic Engineering Fundamentals, and Radio Engineering and Radio Systems. Each chapter is well-illustrated and is followed by a series of questions and problems to test the reader's comprehension of the subject-matter. The chapter on transistors and semiconductors and the section on color TV indicate that the text has been brought completely up-to-date.

* * *

"REPAIRING RECORD CHANGERS" by E. Eugene Ecklund. Published by *McGraw-Hill Book Company, Inc.*, New York. 271 pages. Price $5.95.

This is a practical handbook for service technicians and covers both mechanical and electrical repairs. The text covers the handling of service calls, how a changer works, record-changer actions, service-bench setups, pickups, needles, and records, motors and motor drives, tripping mechanisms, cycling the pickup arm, shut-off mechanisms, special 45 rpm changers and spindles, amplification and compensation, fault location and tests, and magnetic tape recorders.

The material presented is applicable to most commercial changers, but specific procedures have been included on unique circuits or designs.

* * *

"PRINCIPLES OF COMMUNICATION SYSTEMS" by W. D. Hershberger. Published by *Prentice-Hall, Inc.*, New York. 248 pages. Price $6.65.

This book fills the need for a survey of communication systems in general and covers signals and their spectra, the rate of transmission of information, noise, modulation and detection, transmission lines in communication, the characteristics of radio waves, audio frequency systems, radar systems, television, the design of communications, as well as an explanation of the Fourier integral and Bessel's equation.

Needless to say in a book of this compactness, the material is highly

DON'T THROW OLD RADIOS AWAY!

Let this big handbook show you
EXACTLY HOW TO FIX THEM
fast and r-i-g-h-t!

THE ONLY GUIDE OF ITS KIND!

A. A. GHIRARDI

Covers every model made by 202 mfrs. from 1925 to 1942

Including
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Apex • Arvin
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. . . and over a hundred more!

There's a "secret" to fixing old radios fast and profitably . . . and Ghirardi's big 744-page, manual-size RADIO TROUBLESHOOTER'S HANDBOOK is it!

No other guide like it! Gives common trouble symptoms and remedies for over 4,800 models of old home receivers, auto radios and record changers. Contains tube and component data, charts, circuits, etc., available from no other source.

Even beginners can handle jobs slick as a whistle. Makes it easy to repair old sets for which specifications and how-to-fix-it data are no longer available. Just look up the model you want to fix. Four times out of 5, this giant Handbook leads you right to the trouble . . . shows exactly how to fix it. No useless testing. No guesswork. You repair sets in a jiffy that would otherwise go to the junk pile because no one knows what to do with them.

There are over 600 pages of troubleshooting and service case histories. In addition, you get over 300 pages of helpful I-F transformer data; superhet realignment data and alignment peaks; handy troubleshooting reminder charts; auto radio gear ratios; complete data and characteristics on old tube types and components; tube substitution data . . . and dozens of other invaluable service tips and ideas.

10-DAY MONEY-BACK GUARANTEE

Dept. 125, RINEHART & CO., Inc.
232 Madison Ave., New York 16, N. Y.

☐ Send RADIO TROUBLESHOOTERS' HANDBOOK C.O.D. I will pay postman $6.50 plus postal charges.

☐ I enclose check or money order for $6.50. You pay postage. Money will be refunded if I return book in 10 days.

Name .....

Address .....

City, Zone, State .....

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IN **DETROIT** IT'S **AARON**

SCR-274 & ARC/5 Command Equip.

RECEIVERS

1.5-3 MC ARC/5 ....W/Dynamotor, R/New $14.95
100-156 MC ARC/5 ....W/Dynamotor, R/New 14.95
520-1500 KC ARC/5 ....Broadcast, R/New 10.95
3.0 MC BC 454 ....Brand New 6.95
6.0-9 MC BC 455 ....Excel., Less Tubes 3.95
6.0-9 MC BC 455 ....Like New 4.95

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2.1-3 MC ARC/5 ....Brand New 9.95
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Spinner Tuning Knob. For Above Recvr. .... .89

MISCELLANEOUS

Bangamo mica capacitor, type gl. .00024 @ 6000 V. $1.25
Tuning cond. 7 gang, 80-1 dual gear ratio 2.95
40 watt modulation xfmr. 2-1 ratio, matches 6L6's to 807's, etc. with driver and mike xfmr 3.95
PYRL Conds. 23 MFD @ 2000 VDC or 2000 VDC Int. 7.95
8.8 MFD @ 600 VDC filter conds. 4 prong plug in type .... .97

BC221 FREQUENCY METER CASE

Brand new in original carton with all contents and size the same as adv. in previous issues. But priced now at only **$2.25**
BC-221 TECHNICAL MANUAL—NEW. Prepaid..$1.25

TG 10 CODE KEYER

Same function as the TG34A, but larger and more audio output. Can be used as a high power audio amplifier or for group instruction of code. In 7 x standard metal cabinet 11" x 24" x 8½". Used, less tubes and photo cell. Metal cabinet alone worth the price. While they last $9.95
Same as above, excel., tested, with tubes $19.95
Practice Code Tape for TG34A and TG10 Keyers. On 14mm 400 ft. reel, #3, #5, #7, #8, #11, #13, #15. Now in metal container.. **$1.25**

BATTERIES

BB-54-A. 2 volt, 54 AH, plastic case. Dry charged. 4" x 5" x 5½". Wt. 4 lbs. New **$1.95**
Philco, storage, 4 volt, 2 cell unit, 10 AH, glass case. Dry charged. 5" x 3½" x 8. Wt. 15 lbs. New $3.95
Batt. Pack, BA-269. Consisting of 32 miniature cells. Delivering 115 V., @ V., 1.5. Activated with water. Ideal for experimental radio, etc. Used for radiosonde balloons. Wt. 1 lb. New $1.25
One gal. electrolyte, glass container $1.95

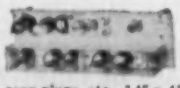
MISCELLANEOUS EQUIP.

Test Set 1-61-E $99.00
Collins 100 watt transmitter 2-4 MC 75.00
Press Wireless CS-121A Cabinet. Includes BC-976E Receiver, BC-991 oscilloscope and control panel PN-21A. 75.00
Testing Teletype Equip. CA 405 .... 75.00
Test Amplifier—flux gate compass 115 V.-60 cy. 69.00
TS 100 Test Oscilloscope. Brand new in original carton (not Demilitarized) 65.00
1 D 118/PNS-1 .... 50.00
Micro Wave Freq. Meter Model 130-C. Frequency 60-215 MC. Lowest Lab 32.00
SN-9/APA-5 Synchroniser 35.00
R-180/ARR-8 .... 30.00
LS-1 Signal Generator, 50-65 MC 27.50
Remote Control Unit RM-23C 27.50
Meissner Signal Shifter 25.00
TS 12 Transmitter 24.50
Signal Generator, Model 78B 32.50
1 D-60/APA-10 Panoramic Adapter. Brand New, Demilitarized. 21 tubes with scope. New .. 24.00
BC-1235A Radio Receiver 30.00
BC-533 100-156 MC with all tubes 32.50
1 D 145/APA-4 .... 24.95
BC-645 Transceiver .... New 17.50
Indicator Scope 1D-6A/APN-4. With all 27 tubes and crystal, excel. 17.50
RT-72/APN-1 .... 15.00
R-87/ARN-5 .... 13.00
R-9B/APN-4 Receiver Power Supply 9.95
BC-1206 Satchell Carlson Beacon Receiver 9.95
Tachometer Field Tester, Type M-S 25.00
BC-1335 Transceiver 14.00
TS-150/TPX 9.95
BC-654A Transceiver 19.95
RM Control Unit—RM 18A .... New 10.00
BC-212 Amplifiers. 2 tubes .... New 2.95
TU-25A Tuning Unit, for the BC-223. In Case 3.25
UHF Transmitter, BC-1253. Freq. 397 MC. Command set tube emitter. Was used for emitting weather data from balloons. 44½" x 25½" x 8". Wt. 2 lbs. New in sealed carton 1.95
BC-357 Receiver, 6-9.05 MC .... Excel. 3.25
T17—Hand Mike. Has thumb control button on handle, used, but checked out .... Excel. 3.25
PE-113 Dynamotor Input—12 V. @ 7 amps. output. 230 VDC @ 90 MA. .... New 9.95

701-A TETRODE. SIMILAR TO 4-125 A 4-250 A

A dandy K.W. 56B final—61; 8 V. @ 7.5 amps. plate: 3000 V. @ 300 MA. screen: 280 V. @ 50 MA. Just 10 W. to drive pair 1 K.W. A.M. phone. Max. input 600 W. per tube, class C. ampli. **$2.95 EA. 2 FOR $5.00.**

HIGH FREQUENCY BROAD BAND IF STRIP



Complete w/8—717A tubes. Has mixer panel for 3—6AK5, 1—6SL7, 1—6SN7, tubes. Will make a dandy TV Video amplifier. Plus—relay, coax plugs, etc. 14" x 4¾" x 4¾". Sh. wt. 6 lb. Can be used for various other VHF applications. With 8—717A tubes. Only **$4.95**
With all the above tubes 7.95

6 METER TRANSMITTER FREQ. 53.3 TO 95 MC.

Complete rf doubler and amplifier section, with 3—215 tubes. Used as xtal osc. buffer, tripler, and final. Easily converted for 2, 10, or 20 meter. Can be used to drive higher power amplifier. Wt. 11 lbs. Brand new in original carton..... **$13.95**

NOTE 25% deposit—bal. C.O.D. or mail full price, allow for postage and save plenty on C.O.D. collection charges.

AARON ELECTRONICS

Dept. S. 3830 Chene St., Detroit 7, Michigan

concentrated and the student should have had undergraduate work in engineering to tackle this text.

* * *

"BRAND OF THE TARTAN" by Virginia Huck. Published by *Appleton-Century-Crofts, Inc.*, New York. 260 pages. Price $3.50.

The story of the *Minnesota Mining and Manufacturing Company*, better known as "3M," from the time it was launched in 1902 to the present time. An inspiration to those who feel that opportunity in the Twentieth Century is limited.

* * *

"BASIC SYNCHROS AND SERVO-MECHANISMS" by Van Valkenburgh, Nooger & Neville, Inc. Published by *John F. Rider, Publisher, Inc.*, New York. Two volumes; $5.50 per set or $2.75 for each volume. Total pages, 272. Paper bound.

Text of a basic course taught in Navy specialty schools. The volumes represent a unique simplification of an ordinarily complex subject. Illustrations are profuse, and enable the subject-matter to be clearly presented without complicated mathematics.

* * *

"THE ELEMENTS OF THE THEORY OF REAL FUNCTIONS" by J. E. Littlewood. Published by *Dover Publications, Inc.*, New York. 71 pages. Price $2.85 cloth, $1.35 paper. Third edition.

This book contains the substance of lectures given at Trinity College, Cambridge, to third year and more advanced second year men. Chapter headings are Classes and Cardinal Numbers, Well-Ordered Series, Other Types of Series, and Elements of the Theory of Sets of Points. —30—

AM-FM Tuner

(*Continued from page 95*)

shown in Table 1 for 22.5 kc. and 75 kc. deviations.

Following the detector, but preceding the de-emphasis network, is the output socket for a multiplex converter. With a suitable converter and amplifier it will be possible to receive multiplex programs on this tuner when they are available.

The audio section consists of a gain stage and a cathode follower output. Although the circuit is somewhat unusual, it is capable of operating with very low distortion and will pass the usual square-wave tests. Distortion measurements taken at various output signal levels are shown in Table 2.

The AM circuit is more or less standard except that it uses a shielded antenna coil istead of a loop. A wire a foot or two long attached to the AM antenna terminals is all that is necessary for good reception.

Other features include a 6E5 eye tube that operates on both the AM and FM bands to provide positive tuning indication and a reference scale on the dial so that the user can quickly locate his favorite stations. —30—

EMERSON CAMPAIGNS

The largest and most comprehensive advertising and sales promotion campaign in the history of the company has been announced by *Emerson Radio and Phonograph Corporation* of Jersey City, N. J.

The campaign will cover the firm's line of radio and TV receivers, phonographs, and air-conditioners. It will include national magazine ads, national newspaper ads, cooperative newspaper ads, trade paper advertising, billboards, and extensive sales promotion material.

The ad campaign is being backed by the most ambitious sales promotion campaign ever undertaken by the company. Comprehensive kits have been sent to all distributors containing streamers, displays, decals, tags, giant banners, pennants, mailers, color displays, color cards, radio sample cases, and various other sales devices and point-of-sale material.

* * *

METAL CHASSIS DISPLAY

Premier Metal Products Co., 3160 Webster Avenue, New York 67, N. Y., has developed a unique counter display which adds a lift to the common metal chassis.

The display holds a new aluminum chassis, emphasizes its improved design and invites the customer to pick it up and inspect the new features of the chassis. A "gimmick" slide-on figure reads "Pick me up" on the front and in back, "Please don't take me home".

The campaign includes sales bulletins to all dealers telling them how to use the display and ads in trade magazines promoting the chassis.

* * *

FINNEY ANTENNAS

The Finney Company, 4612 St. Clair Ave., Cleveland 3, Ohio, has opened an intensive and hard-hitting campaign to merchandise its new "Geomatic" series of broadband u.h.f.-television antennas.

Not only has *Finco* launched an intensive trade journal, newspaper, and direct mail campaign, but it has offered to double, at no extra charge, the initial order for these antennas placed by its established distributors. Initial orders on the 'Geomatic" lines are limited to 12 antennas (the company will ship 24) but any "B" model or combination of "B" models in the company's line can be purchased by the

distributor on the "double-bonus" plan.

The company announced the bonus-gift offer to its distributors in a special 15" x 12" personalized zipper case

which contained full details of the plan.

For details on distributor territories still open, write M. L. Finney, sales manager of the firm.

* * *

NEW MELLOTONE DISPLAY

Wendell Plastic Fabrics Corp., 17 West 17th Street, New York 11, N. Y., has added a new 18" x 24" "Mellotone" package and free display unit to its line due to the demand for grille cloth in this quantity.

The display for these packages can be attached to a counter, a wall, a shelf, or used in almost any spot in a retail or wholesale establishment. Samples of the product now supplied in this new size package are available from the manufacturer.

* * *

"BONUS PACK"

A new merchandising campaign featuring the *International Rectifier Corporation* "Bonus Pack" is finding wide distributor acceptance.

Each of the "Bonus Pack" units contain four TV replacement rectifiers—a "pair" and a "spare pair". As a special introductory offer, the technician receives a free nylon TV alignment tool as a premium. This new packaging plan will help both the jobber and the technician in handling and stocking the TV replacement rectifiers.

Additional details on this campaign

and the "Bonus Pack" itself are available from the company at 1521 E. Grand Ave., El Segundo, Calif.

* * *

COLOR TV PROMOTION

Plans have been completed for the most extensive advertising drive thus far launched by the *RCA Victor* Television Div. to promote its 21" color sets.

In addition to a nationwide, all-media campaign, the company is following up with a hard-hitting cooperative drive at the local level. In addition to the advertising schedule, the Division has prepared extensive distributor-dealer promotional kits to tie-in with future colorcasts.

* * *

VIDAIRE'S "COUNTER SALESMAN"

Geared to the rapid turnover of inventory, *Vidaire Electronics Mfg. Corp.* of Lynbrook, N. Y., has recently introduced a new "Counter Salesman" which will merchandise the firm's extensive line of radio and TV accessories.

The display is only 15" wide but is printed in blue and yellow for maximum eye-stopping appearance. The components are arranged in such a way that the dealer can run a daily inventory at a glance. The "Counter Salesman" is being distributed to jobbers without charge upon the purchase of a small initial order.

* * *

ALTEC "ROAD SHOW"

Altec Lansing Corporation, 9356 Santa Monica Blvd., Beverly Hills, Calif., and 161 Sixth Ave., New York 13, N. Y., has scheduled an elaborate "Road Show" for some 70 cities throughout the United States to promote its 1956 high-fidelity line.

The "Show" is an ambitious production employing four crates of props, including a unique display piece containing all of the company's components, on a stage 20 feet wide, together with a special motion picture film dealing with the company's product and methods of manufacture.

The arrival of the show will be announced locally in each of the cities the "Road Show" will visit.

* * *

"SILVERAMA" TUBES

The introduction of its new "Silverama" aluminized television picture tubes is being supported by an extensive and comprehensive promotion campaign launched by the Tube Division of *Radio Corporation of America*, Harrison, New Jersey.

Four media will be used in the campaign: national consumer magazine advertising, spot announcements on radio and television, trade advertising in local newspapers as well as window display kits, store banners, and colorful decals for stores and trucks, together with mailing pieces for distribution by dealers.

Dealers handling the *RCA* line are advised to contact their local distributors for full information on this promotion. —30—

NOW HEAR THIS

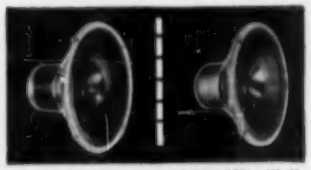
for

improved high fidelity

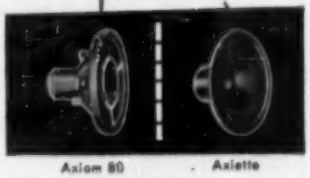
GOODMANS
LOUDSPEAKERS

in the New

'Friction-Loaded'
AXIOM Enclosures



Axiom 22 Mk II Axiom 150 Mk II



Axiom 80 Axiette

Complete *do-it-yourself* construction details — available on request

Mail this Coupon...Today

ROCKBAR CORPORATION Dept. NM-5
215 East 37th St., New York 16, N. Y.
Please send me:
☐ Complete information about GOODMANS High Fidelity Loudspeakers.
☐ Complete details about the new 'friction-loaded' AXIOM Enclosures.

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STAN-BURN
S-P-A-R-K-S

CATHODE RAY TUBE SPECIALS

ONE YEAR GUARANTEE

G.E.	Type	STAN-BURN	G.E.	Type	STAN-BURN
$11.25	10BP4	$10.20	$26.15	17CP4	$19.50
16.00	10FP4	14.00	31.25	17GP4	26.75
16.25	12LP4A	13.95	32.25	19AP4A	22.50
	12QP4	18.50	27.40	20CP4	19.95
28.95	12UP4	24.50	33.00	21AP4	22.75
18.15	14CP4	13.40	32.25	21MP4	22.50
	15DP4	14.50	27.40	21EP4	20.15
31.25	16AP4A	16.00	98.75	24AP4	49.00
26.25	16KP4	18.75	**DUMONT TUBES**		
31.25	16GP4	16.50	120P4A	23.75	26.00
29.00	16LP4	19.25	150P4	26.55	25.00
29.00	16MP4	16.25	160P4A	31.00	33.25
22.50	17BP4	15.75			38.50

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

PORTABLE RADIOS

JEWEL 8 TUBE SUPER HET AC-DC—Red, Ivory, Walnut, and Ebony **$12.50**
Same with automatic clock & alarm. IVORY $15.95. WALNUT $16.45

RECORD PLAYERS

Manual 3 speed record player—Single needle ..$14.50
Manual 3 speed with FLIP-OVER CARTRIDGE ..$16.95
Automatic 3 speed with VM CHANGER $37.50

$30 WORTH OF ELECTRONIC PARTS IN GRAB-BAG consisting of: Porcelain sockets, coils, speaker, transformers, resistors, condensers, etc. ONLY $1.98 (plus 50¢ postage).

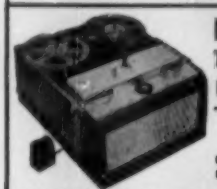
TURNER AU PHONO CARTRIDGE—Universal replacement. Low/high output...$1.00 ea.; 6 @ $5.49 ea.

VM 3 SPEED HI-FI CHANGER—Model 990 with Bonette Sonotone or Astatic flip-over cartridge—BRAND NEW, ORIGINAL CARTONS $21.45

WEBSTER Model 140—3 SPEED Automatic with Bonette Sonotone or Astatic flip-over cartridge...$22.49

RC34 Collaro with Bonette flip-over cartridge..$32.00
With G.E. plug in RPX050 ..... $30.95

TUBE BRIGHTENERS.....69¢ ea.; 6 for $3.00



PENTRON
TAPE RECORDERS
New '56 Models

MODEL T-90
(Illustrated)
dual speed, dual track **$189.50** list

SPECIFICATIONS—Frequency range: 50 to 10,500 cycles at 7½" per sec. Signal to Noise Ratio: 50 db. Flutter: Less than 0.3% @ 7½" per sec. Operating Speeds: Both 7½" and 3¾" per sec. with push-pull speed change. Recording time: 3 hours using long play tape. Recording level indicator: Magic eye. Power Output: 5 watts. Speakers: (2) 1 woofer, 1 tweeter.

MODEL HF-400 (3 speaker High Fidelity) $249.50 list
SPECIFICATIONS: Frequency Range: 40 to 12,000 cy @ 7½" per sec. Speakers: 2 woofer, 6", 1 tweeter 4". Signal to Noise Ratio: 50 db. Power Output: 10 watt push-pull. Flutter: Less than 0.3%. Controls: UNIMAGIC single lever for Play or Record, Fast Forward or Rewind. Operating Speeds: Both 7½"—and 3¾" per sec. with push-pull speed change. Recording Times: Up to 3 hours recording using long play tape.

MODEL RWH (Monomatic Control).....$129.50 list
SPECIFICATIONS—Frequency Response: 50 to 9000 cy. Signal to Noise Ratio: 42 db. Flutter: Under 0.5%. @ 7½" per sec. Operating Speeds: Both 7½" and 3¾" per sec. Controls: MONOMATIC CONTROL: Provides instant selection of Record or Play, in either tape speed, as well as Fast Forward and Rewind. Recording Time: 3 hours using long play tape. Recording Level Indicator: Neon Bulb. Power Output: 4 Watts.

Model TM-56—Tape Mechanism.....@ 77.75 list
Model P-4—Tape Pre-amplifier..... 77.75 list
Model MP-2—Model TM-56 and P-4 in carrying case)..... $74.50 list
(Catalogs and dealers' prices sent on request)

DEALERS: Write for low cost prices and catalogs on '56 models—HALLICRAFTERS, CRESCENT, FANNON, SONORA, WILCOX-GAY, TECHMASTER, G.E., WESTINGHOUSE, TUNG-SOL, DeWALD, TECHMASTER, DELCO, GEN. MOTORS. Address all inquiries to Dept. RN-12.

We invite export inquiries and offers. Our export department will give special attention to expediting foreign orders at minimum commissions. We are authorized distributors for United Motors, all Delco and Gen. Motors Auto Radio parts in stock. We also carry a complete line of popular makes of Radio Tubes at 50/10 discount. Also many other special purpose and transmitting types, and all electronic parts and equipment at lowest prices. Send us a list of your requirements for prompt quotations. Terms: 20% with order. Balance C.O.D. All prices F.O.B., NEW YORK Warehouse. Minimum order $5.00. Write for our latest price list and Hi-Fi Catalog 56-12.

STAN-BURN RADIO and ELECTRONICS CO.
558 CONEY ISLAND AVE. • B'KLYN 18, N. Y.

Within the Industry
(*Continued from page 26*)

been appointed advertising and promotion manager for *Hammarlund Manufacturing Company, Inc.* . . . **RICHARD B. LENG** has been elected to the newly-created post of vice-president in charge of the Technical Products Division of *Packard-Bell Company*. He was most recently associated with *Sylvania's* California operations . . . Appointment of **BENJAMIN C. BOWKER** as public relations manager has been announced by the *Allen B. Du Mont Laboratories, Inc.* . . . **C. L. PETERSON** has been appointed vice-president and general manager of the *Brown Instruments Division* of *Minneapolis-Honeywell*. He has been with the firm for 28 years . . . **R. F. ROBERTS** has joined *National Electronics, Inc.* of Geneva, Illinois as sales manager of the firm. He was formerly manager of equipment manufacturer sales for the *Westinghouse* tube division . . . *Robertshaw-Fulton Controls Company* has named **R. S. REYNOLDS, JR.** to the post of chairman of the board succeeding his father who passed away in July . . . *Brush Electronics Company* has elected **DR. DAVID B. PARKINSON** to the post of vice-president and general engineering manager and **JOHN H. HARRIS** as vice-president and general works manager . . . **KENNETT W. PATRICK** has been named director of the transducer division of *Consolidated Engineering Corporation* . . . *Cook Electric Company* has appointed **HUBERT J. THOMISZER** manager of its Magnilastic Division and **EARL WASHBURN**, manager of the Electronic Systems Division . . . *Harman-Kardon, Inc.* has added **ROBERT G. BACK** to its executive staff as advertising and sales promotion manager . . . **WILBERT H. STEINKAMP** has been appointed vice-president of sales of the *Weston Electrical Instrument Corp.*, a subsidiary of *Daystrom, Inc.* . . . **DR. WALTER G. DRISCOLL** has been appointed assistant director of research at *Baird Associates, Inc.* He will be in charge of the company's transistorized electronics department . . . **EDWARD KEDZIORA** has been promoted to the position of vice-president in charge of contract sales for *Sonora Radio & Television Corp.* He has been with the firm for 15 years . . . **JOHN D. THUET** has been appointed radio sales manager for the Radio and Television Division of *Sylvania* . . . *Elgin National Watch Company* has appointed **DONALD JONSON** to the post of sales supervisor in the electronics division. He will coordinate work in sales of microphone and relay products for the firm's West Coast electronic subsidiaries . . . **JOHN L. BRADLEY** is the new assistant manager of advertising and sales promotion at *Ampex Corporation* . . . **STEVEN GALAGAN** has been named director of engineering for the *Gabriel Laboratories* and the *Gabriel Electronics Division*.

* * *

EDWARD E. WINEBLATT has been appointed general manager of *Radio Merchandise Sales Inc.* of New York, manufacturer of TV antennas, accessories, and intercoms.

His duties at the company will include implementing the sales expansion program now underway. He is well known in the parts distributor field.

He is a graduate of the Massachusetts school system and attended Boston University.

* * *

I.D.E.A., INC. of Indianapolis, Ind. has acquired **RADIO APPARATUS CORPORATION** of the same city by means of an exchange of common stock. The subsidiary firm will operate as the **MONITORADIO DIVISION** of the parent firm . . . **PRECISION RADIATION INSTRUMENTS INC.** of Los Angeles has purchased **RADIO CRAFTSMEN**, Chicago manufacturer of a line of audio equipment and accessories . . . **MAR VISTA ELECTRONICS CO.** has purchased the semiconductor production facilities of **HYDRO-AIRE, INC.** but will move to expanded facilities in the Los Angeles area from the plant at 3000 Winona Ave. in Burbank in the near future.

* * *

RETMA reports that retail sales of television receivers during the first eight months of this year were approximately 14 per-cent higher than during the same period in 1954.

During August, a greater number of both radio and TV sets were sold than was the case in either July of this year or August of last year. TV sets sold January through August this year totaled 4,771,139 units while radio set sales reached a total of 3,189,608 for the first eight months. —30—

SERVICE BUSINESS TALKS

IN ORDER to help TV and radio service dealers develop a better understanding of the basic business elements involved in their profession, the Associated Radio and Television Servicemen of Chicago (ARTS) has been presenting a free lecture series with the accent on business problems. The series began on October 25 with a talk on credit and financing. On Wednesday, December 14, Mr. Eugene Reichstetter, manager of Dun & Bradstreet in Chicago, will deliver a lecture on credit ratings and collections for the owner of a small shop.

The last lecture of this series will be given on January 17, when Mr. L. J. Couch of Sylvania Electric Products Inc., talks on "The Transistor Story." Another series will start after the conclusion of the first, and like the first, will be limited to two men from a shop. For additional information, contact Howard Wolfson, Chairman ARTS, 433 South Wabash Avenue, Chicago, Ill. —30—

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Our Kit is designed to provide a fundamental background in radio, with the basic facts of Radio Theory and Construction Practice expressed simply and clearly. You will gain a knowledge of basic Radio Principles involved in Radio Reception, Radio Transmission and Audio Amplification.

You will learn how to identify Radio Symbols and Diagrams; how to build radios, using regular radio circuit schematics; how to mount various radio parts; how to wire and solder in a professional manner. You will learn proper chassis layout. You will learn Printed Circuitry. You will learn how to service and trouble-shoot radios. You will learn code. You will receive training for F.C.C. Novice License. You will learn High Fidelity.

In brief, you will receive a practical basic education in Radio, worth many times the small price you pay.

THE KIT FOR EVERYONE

The Progressive Radio "Edu-Kit" was specifically prepared for any person who has a desire to learn Radio. The Kit has been used successfully by young and old in all parts of the world. It is not necessary that you have even the slightest background in science or radio.

The Progressive Radio "Edu-Kit" is used by many Radio Schools and Clubs in this country and abroad. It is used by Armed Forces Personnel and Veterans throughout the world.

The Progressive Radio "Edu-Kit" requires no instructor. All instructions are included. All parts are individually boxed, and identified by name, illustration and diagram. Every step involved in building these sets is carefully explained.

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The Progressive Radio "Edu-Kit" comes complete with instructions. These instructions are arranged in a clear, simple and progressive manner. The theory of Radio Transmission, Radio Reception, Audio Amplification and servicing by Signal Tracing is clearly explained. Every part is identified by illustration and diagram. You will learn the function and theory of every part used.

The Progressive Radio "Edu-Kit" uses the principle of "Learn by Doing." Therefore you will build radio circuits, perform jobs, and conduct experiments to illustrate the principles which you learn. These circuits are designed in a modern manner, according to the best principles of present-day educational practice. You begin by building a simple radio. The next set that you build is slightly more advanced. Gradually, in a progressive manner, you will find yourself constructing still more advanced multi-tube radio sets and doing work like a professional Radio Technician. Altogether you will build Receiver, Transmitter, Code Oscillator, Signal Tracer, Signal Injector Circuits—16 in all. These sets operate on 105-125 V. AC-DC. For use in Foreign Countries having 210-250 Volt Sources, an Adaptor for 210-250 V. AC-DC operation is available.

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You will receive every part necessary to build 16 different radio circuits. Our "Edu-Kit" contains all tubes, tube sockets, variable, electrolytic, and paper condensers, resistors, tie strips, coils, hardware, tubing, Instruction Manuals, Printed Circuit Materials, etc. No solder or wire included.

Every part that you need is included. These parts are individually packaged, so that you can easily identify every item. A soldering iron is included, as well as an Electrical and Radio Tester. Complete, easy-to-follow instructions are provided. All parts are guaranteed, brand n.w. carefully selected and matched.

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Trouble-shooting and servicing are included. You will be taught to recognize and repair troubles. You will build and learn to operate a professional Signal Tracer and Signal Injector. You will receive an Electrical and Radio Tester, and learn to use it for radio repairs. While you are learning in this practical way, you will be able to do many a repair job for your neighbors and friends, and charge fees which will far exceed the cost of the "Edu-Kit." Here is your opportunity to learn radio quickly and easily and have others pay for it.

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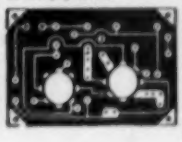

You build a Printed Circuit Signal Injector, a servicing instrument that can detect many Radio and TV troubles. A Printed Circuit is a special insulated board on which has been deposited a conducting material which takes the place of wiring. Various parts are plugged in and soldered to terminals. This new process is now popular in commercial radios, TV, hearing aids, etc.

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1930 *Golden Crest*

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Designed for those who appreciate the finest in Hi-Fi reproduction—the very best for less. Features: Full 20 watts output; response, ± 0.5 db, 20 to 40,000 cps; 6 response curves (compensation for all record types); 5 inputs for complete hi-fi versatility; separate bass, treble controls; contour and volume controls; variable damping control; rumble filter, plus many other deluxe features. In compact cabinet, 4" high.

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RAULAND-BORG CORPORATION

3515 W. Addison St., Dept. 5, Chicago 18, Ill.

Capacity Meter

(Continued from page 55)

potential. This clamp is the key to successful operation of the circuit, since the grid voltage, if allowed to rise above ground potential, will cause distortion in the waveform appearing across the common cathode resistor.

This 100-ohm cathode resistor, common to both sections of the 6BX7 multivibrator, acts both as the common coupling impedance, necessary to sustain oscillation, and as the low-impedance source of pulses to the metering circuit. This impedance is much lower than the metering circuit, thus obviating the possibility of interaction between the meter circuit and the oscillator.

The waveform appearing across the 100-ohm cathode resistor is a positive-going pulse, having a peak amplitude of approximately 7½ volts. The top of this rectangular pulse is essentially flat, rise time is 0.1 microsecond, and the decay time is less than 0.1 microsecond. Pulse repetition rates vary between 100 kilocycles on the "100 μfd." range and 100 cycles on the "0.1 μfd." range.

The metering circuit uses a type 1N34A germanium diode as a shunt rectifier, supplying rectified voltage to the 50 microampere meter through a multiplier resistor. A capacitor shunted across the meter damps out the residual reading, and is not critical as to value. The meter is not connected into the circuit except during measurement of an unknown capacitor.

A group of four capacitors, in conjunction with four separate calibrating potentiometers, controlled by the "Range" switch, establish the frequency of oscillation, and therefore the maximum capacitance which may be measured. The instrument has four decaded ranges: 0-100 μμfd.; 0-1000 μμfd.; 0-.01 μfd.; and 0-0.1 μfd. Each range is calibrated separately, and the accuracy of capacity measurement is wholly dependent upon the accuracy of the meter calibration, and the accuracy of the standard capacitors used for calibration. The meter in the Model CM-1 has been especially calibrated to eliminate the effects of nonlinearity in the meter movement. Standard calibrating capacitors are included with each instrument in the following values: 100 μμfd. ± 1%; 1000 μμfd. ± 1%; 0.01 μfd. ± 2%; 0.1 μfd. ± 2%; Assuming even as much as 2% maximum meter deviation, it is obvious that the CM-1 will be, at worst, within ± 3% through 1000 μμfd., and ± 4% through 0.1 μfd. In practice, accuracies much better than these may reasonably be expected.

In operation the "Range" switch selects the proper combination of cross-coupling capacitor and calibrating potentiometer, which serves to shunt the back-resistance of the 1N34A germanium diode clamping the grid. The unknown capacitor is connected in series

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BC-221, Freq. Meter 125Kc.-20Mc. with Calibration Book and Xtal	Excellent	99.50
Esterline-Angus Model AW Recording Voltmeter 0.10V. AC. 400 Ohms	Excellent	150.00
Weston Model 686 True Mutual Conductance Vacuum Tube Analyzer	New	450.00
MG-149F Inverter	Excellent	49.50
FT-524 General Elertric 3200 Wattsecond Photoflash Tube	New	20.00
80 Mfd. 4000 V. 640 Wattsecond Photoflash Capacitor	New	50.00
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with the meter circuit and the pulses appearing across the 100-ohm cathode resistor. The positive-going leading edge of the pulse and the flat top are coupled to the shunt rectifier through the unknown capacitor, and are therefore shunted directly to ground. However, the negative-going trailing edge of the pulse is differentiated by the combination of the unknown capacitor and the meter impedance, rectified by the 1N34A germanium diode in shunt with the metering circuit, and the average level of voltage of the differentiated pulse is displayed on the meter in units of capacitance.

Actual operation of the Model CM-1 exceeds in simplicity even the operation of a d.c. voltmeter, since polarity is of no concern. The "Range" switch is set to the highest (0.1 μfd.) position, and the unknown capacitor is connected across the two binding posts on the panel. The meter will display a reading equivalent to the value of the unknown capacitor. If the reading is less than 10 per-cent of the scale, the "Range" switch is set for lower values of capacitance until the meter reading exceeds 10 per-cent of full scale, at which time the value of the unknown capacitance may be read directly on the meter. If the approximate value of the unknown capacity is known, the lowest range capable of indicating the assumed capacity may be used, obviating the necessity of starting with the highest capacity range.

The uses to which the "Direct Reading Capacity Meter" may best be put are many and varied. Since the residual capacity is less than 1 μμfd., it will be necessary to subtract this only on the lowest capacity range, making the measurement of even the smallest capacitors easy and accurate. The capacity range of variable capacitors, from tiny trimmers to large broadcast radio gangs, may be rapidly determined. It is especially useful in measuring capacitors from bulk stock for specific values, and in discovering the values of unmarked capacitors, or those having unknown or obsolete color codes. Matched pairs may easily be made up from stock capacitors at a considerable saving in over-all cost, compared to factory-matched pairs. Tuned circuit alignment, where printed inductances are used, is enhanced since the tuning capacitors may be pre-set prior to assembly. The "Direct Reading Capacity Meter" is especially valuable for production line spot checking, choosing specific values of capacity for audio phase shift networks, determining suitable capacitors for high- and low-pass filters; in fact, any capacitance measuring job within its capabilities.

Accuracy of measurement is not affected by hand capacity, nor by the presence of electric or magnetic fields. Operation is completely stable after a nominal warm-up period. Accuracy is maintained over long periods of time, and is unaffected by usual line-voltage excursions. —30—

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Cash-in on television's fastest growing market by selling master TV systems to motels, apartments, clubs, schools, and hotels. This big, data-packed booklet explains every step . . . from making cost estimates of each job and selling an installation to laying-out the system, calculating DB gain and loss, locating and installing equipment, maintenance, servicing, and much more. Every calculation is figured out for you—no complicated mathematics needed. Over 35 helpful photos, charts, diagrams, and schematics make things doubly easy to understand.

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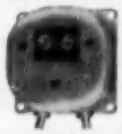
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New...

CONTROL FOR MANUAL OPERATION
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WESTON TEST EQUIPMENT

A 16-page catalogue which illustrates and describes the complete line of test equipment manufactured by the firm is now available from *Weston Electrical Instrument Corporation*, 614 Frelinghuysen Ave., Newark 5, N. J.

The new Catalogue R36A includes all instruments for servicing TV, radio, and other communications equipment, as well as all industrial electronic and electrical equipment. The booklet also describes the company's new simplified method of visual alignment, an accurate and simplified method for servicing TV receivers.

The company will supply copies of this catalogue without charge upon written request.

TUBE TESTER BULLETIN

B&K Manufacturing Co., 3726 N. Southport Ave., Chicago 13, Ill., has available a colorful bulletin on its new "Dyna-Quik" Model 500 Dynamic Mutual Conductance Portable Tube Tester.

The new bulletin tells what the unit will do and how it benefits both the service technician and his customers. The text points out how quickly and accurately the technician can make a complete check of TV and radio tubes under actual operating conditions right in the home, how the tester cuts operating costs, increases on-the-spot tube sales, and improves servicing.

Bulletin No. 500 is available without charge on request.

HIGH-VOLTAGE RESISTORS

International Resistance Company, 401 N. Broad St., Philadelphia 8, Pa., is offering an 8-page bulletin which provides comprehensive data on construction, specifications, installation, tolerance, voltage coefficient, temperature coefficient, ratings, insulation, terminations, etc., of its Type MV high-voltage resistors.

Detailed charts and graphs are included in Catalogue Data Bulletin G-1a, which is available without charge on request.

CBS CRYSTAL DIODE MANUAL

The second edition of its "Crystal Diode Manual" is currently available from local *CBS* tube distributors or from *CBS-Hytron*, Danvers, Mass.

Designated as Bulletin E-217, the new edition includes data on germanium and silicon diodes, glass-encased and plastic encased. In addition, the manual continues the down-to-earth, informative approach which characterized the first edition. The manual itself is divided into three parts covering construction and advantages, electrical and mechanical data, and selection and application.

The manual is available without charge.

1956 NEWARK CATALOGUE

Newark Electric Company, 223 W. Madison St., Chicago, and 4736 W. Century Blvd., Inglewood, Calif., has just issued its 1956 catalogue on electronic parts, tubes, equipment, and accessories.

The 260-page catalogue, featuring 64 pages on high fidelity and complete listings of literally thousands of electronics items, marks the company's 33rd year in electronics. All of the items listed in the new catalogue are available at both of the firm's outlets.

Write to the nearest location for your copy of this catalogue.

KIT CATALOGUE

General Electronic Equipment Company, P. O. Box 347, Easton, Pa., has announced the availability of a new, two-color brochure which describes its new line of kits and completely-wired instruments merchandised through local distributors.

The booklet includes details on oscilloscopes, tube testers, Geiger counters, and multitesters. Distributors are invited to write for reasonable quantities for mailing enclosures, etc. Space is provided for the distributor's imprint.

DIELECTRIC CAPACITORS

A 2-page, 2-color catalogue sheet describing and listing a complete new line of ultra high stability Polystyrene dielectric capacitors is now available from *Corson Electric Mfg. Corp.*, 540 39th St., Union City, N. J.

The capacitors are designed for use where low leakage and low dielectric absorption are important. The sheet shows standard units which come in bathtub and rectangular can types in 200, 400, and 600 volt ratings in capacitances from .05 μfd. to 25 μfd.

Also described are special units which may be ordered with a variety of housings and terminals, still lower temperature coefficients, higher insulation resistance, silicone impregnation, lower power factors, and other special specifications.

RETMA BOOKLET

Radio-Electronics-Television Manufacturers Association, 777 14th St., N. W., Washington 5, D. C., has just issued a "Fact Book" on the radio-television-electronics industry.

The booklet points out that the electronic industry was producing equipment at an annual going rate of approximately $5.6 billion at the start of 1955 and employs over half a million people.

It also reveals that in the nine years of commercial television (since 1946), nearly 40 million TV receivers have been produced and that 230 million radio receivers have rolled off the production lines since 1922.

The "Fact Book" was prepared as a joint venture of the RETMA Editorial

and Statistical Departments. Individual copies are available without charge from the Association.

V.T.V.M. LINE

Technology Instrument Corporation, 531 Main St., Acton, Mass., is now offering copies of its 8-page brochure which describes the outstanding features of its new extended range v.t.v.m. line.

Included in the booklet are complete details on the Type 800A and 800B instruments. In addition, the company has issued another in its series of periodic laboratory reports, this one entitled "Basic Theory of the Type 300A Vacuum Tube Voltmeter," and discusses in detail the design considerations, giving basic circuits and development logic.

Both brochure No. I-105 and the laboratory report No. 16 are available by writing to W. R. Sullivan of the company.

MASTER TV MANUAL

A completely new "Master TV Installation Manual" has just been issued by *Blonder-Tongue Laboratories* of 526-536 North Ave., Westfield, N. J.

Available without charge, the new 12-page booklet discusses all types of multiple TV systems, industrial TV systems, and the proper use of the firm's "Masterline" equipment.

Illustrated sections cover antenna and line installation, signal distribution, closed-circuit TV, system maintenance, and troubleshooting procedures. Simplified charts and tables, with specific examples, show how to calculate signal levels at any point. All of the company's amplifiers, converters, tap-offs, and accessories are fully described.

STEPHENS AUDIO EQUIPMENT

Stephens Manufacturing Corporation, 8538 Warner Drive, Culver City, Calif., has available a series of catalogue data sheets covering its line of "Tru-Sonic" audio products.

Information on all types of speakers and speaker enclosures is provided in this colorful folder. Each data sheet provides complete specifications on one or more of the units in the firm's line.

Please specify Catalogue 55 when writing for this data.

HEATH FLYER

The Heath Company, a subsidiary of *Daystrom, Inc.,* Benton Harbor, Mich., has issued a colorful flyer which gives data on the complete line of electronic equipment in kit form available from the company.

One of the new items to be introduced is the Model FM-3 FM tuner kit whose specifications are given in the publication. In addition to providing brief descriptions of the other items in the line, the flyer also contains an order blank and full instructions for ordering any of the instruments pictured and described. —30—

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TELLS HOW TO ANSWER RADIO T.V. QUESTIONS

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ASK TO SEE IT! IT WILL PAY TO KNOW—The Basic Principles—Construction—Installation—Operation—Repairs—TroubleShooting. Shows How to get Sharp, Clear T.V. Pictures. Install Aerials—How to Test. Explains Color Systems, Methods of Conversion, Terms, etc. Includes Ultra High Frequency—Valuable for Quick Ready Reference and Home Study.

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PICTURE TUBES
- RCA Licensed
- One Year Unconditional Guarantee

Type	Price	Type	Price
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16LP4	$19.38	24AP4	$42.50

Picture Tubes shipped F.O.B. Harrison, N. J. Above types are most popular. However you may order any equivalent size at the same price.

LOOK WHAT YOU GET FREE!

FREE BONUS BOX With Every $25 Order
- 1 RCA Cheater Cord
- 10 Assorted resistors
- 10 assorted 2 color "blank" tube cartons
- 1 6BQ6GT tube
- 1 6AU6 tube
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Wakemaster clock radio with famous Sessions clock movement wakes you to music or alarm. May be purchased outright from MAJOR BRAND for $17.95. In ivory or rust.

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WE PAY ALL POSTAGE on orders shipped in USA, Territories and APO's. Send only purchase price of merchandise. Please include approximate postage on foreign shipments. All orders subject to prior sale. Add 25c handling on orders under $5.00. Quantity users write for special discount.

Write For FREE Tube List — Order Blank — and FREE Sample Tube Carton. We want Y-O-U On Our Mailing List!

NEW INDOOR
ANTENNA
Both UHF and VHF. Brings better reception than most outdoor antennas. Use on top of TV.

List Price $9.95

Your Price

Lots of 3 $3.29

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Clip out this ad and attach it to your order. Three 6SN7GT's will be shipped FREE with any order of $10 or more.

HERE'S HOW LIFETIME GUARANTEED TUBES SAVE YOU MONEY!
- We Guarantee to Replace Tubes Labeled MAJOR BRAND Forever
- Each Tube Individually Boxed and Guaranteed
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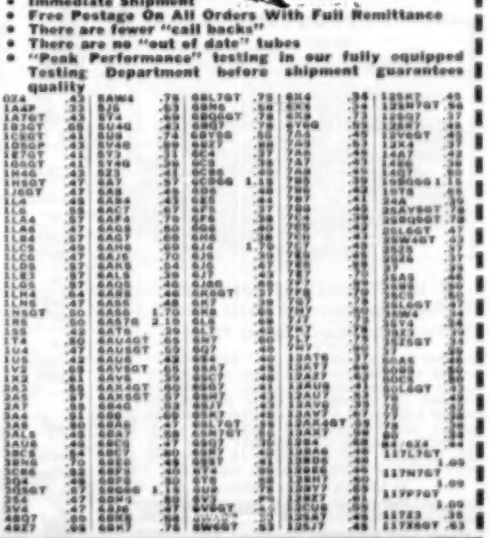

Write Dept. 12-RN

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Professional Tape Recorder

SPECIFICATIONS
- "Micro-Linear" Heads
- Three Speeds
- Three Motors
- Meets NARTB Standards
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- Straight Line Threading
- 4" Dual Lighted Meter
- Magnetism Braking
- Perfect Erasure

★ ★ ★ ★

GUARANTEED
Record & Playback Performance

IPS	15	7½	3¾
% WOW	.12	.18	.25
DB	+2	+2	+3
CPS	20 to 22,000	30 to 15,000	50 to 10,000
NOISE RATIO	55	52	44

for Full Track Heads

CROWN PRINCE

Breaks Sound Barrier
20-20,000 CPS usable at 7½ IPS

The only Complete Professional Recorder as a single easily portable unit using 10½" reels . . . Three speeds: 15, 7½, 3¾ IPS . . . 10½" reels—can be rack mounted . . . Hi-Z Mike and Phono Input . . . Cathode Follower Output . . . Size: 19" x 14" x 7½". Wt. 38 lbs.

Dual Track—$349.50 **Full Track—$399.50**

Complete less case.
Write for literature. Address Dept. RN12.

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Elkhart Indiana

THE CHANGER THAT LEADS A **DOUBLE LIFE**

MIRACORD XA-100

with PUSHBUTTON CONTROL and the "MAGIC WAND" SPINDLE

PERFECTION

2 INSTRUMENTS IN ONE!
(1) Pushbutton Automatic Record Changer
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No Other Changer Like It! Unique "MAGIC WAND" Spindle changes records with gentle care—no pusher arms, no stabilizing plates! INTERMIXES 10" and 12" records. Exclusive PAUSAMATIC permits 5 second to 5½ minute interval between records. HEAVY-DUTY 4-POLE MOTOR. No wows, no rumble. Compact size, decorator styled. SEE FOR YOURSELF WHY MIRACORD IS AMERICA'S MOST POPULAR 3-SPEED RECORD CHANGER!

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CONTROL DOPE
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the quality product that does all the lubricating and cleaning jobs on TV and radio . . . nothing does the job as well as Quietrole . . . and you can depend on that."

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Mac's Service Shop

(*Continued from page* 74)

the low intensity inner shield takes over and reduces this to a small fraction of a gauss."

"Some of these sheets are coated with large coarse particles while others have a much finer grain," Barney remarked.

"That's right. The ferrous and ferrite powders are frequency sensitive. For low frequency and magnetostatic fields, large particle sizes are used with a mesh of 20 to 50. As the frequency increases, the particle size supplying the most effective shielding decreases until for some purposes particles of 2000 mesh are used. By combining different mixtures and different particle sizes, shields can be tailored for maximum attenuation of any frequency from d.c. to two hundred megacycles."

"Then it's really important to know exactly what sort of magnetic fields you are trying to shield against in selecting your shields."

"The salesman was very emphatic about that. While general purpose shields will do a perfectly satisfactory job in many applications, maximum attenuation of a particular field can be had only when that field is measured and identified and the shield designed for it."

"Well, let's put the shield on the scope and see what happens," Barney urged.

"OK, but first let's take a couple of readings. With the vertical and horizontal gain controls of the scope turned entirely off, I'm going to hold this speaker magnet right against the side of the case at the point where it has the most influence on the spot position and see how far we can displace the spot. Hm-m-m, it looks like we can move the spot a full inch up or down from center simply by turning the magnet around. Now I'll hold the solder gun—which the salesman said was the most vicious generator of an a.c. field he had found—in the same place and pull the trigger. That produces a line slightly more than four inches long. Remember these figures."

In a few minutes Mac had slid the scope from its case, installed the shield over the CR tube, and put the instrument back in its housing. Once more he held the speaker magnet against the side of the case.

"Golly, that spot can't be moving more than a sixty-fourth of an inch if it moves at all," Barney marvelled.

Next Mac pushed the solder gun housing against the case of the scope and pulled the trigger. Instead of a four-inch-long line, the spot traced out a segment only about a fourth of an inch in length.

"Something else has changed, too," Mac remarked. "These center-tapped positioning controls have a small bit of knob travel at the center of rotation where the slider is moving across the junction of the tap and the resist-

ance element in which no effect on spot positioning is had. Before we put on the shield, this 'dead spot' was clear over to one side of center; now it appears when the spot is right in the middle of the five-inch screen, proving that the influence of a d.c. field has been removed."

"You think a CR tube shield is an absolute necessity on a scope, huh?"

"No, I don't think that. In many instances, especially where the scope is operated in a location comparatively free from strong magnetic fields, the shield will make little essential difference. Modern scope manufacturers use power transformers especially designed to restrict any influence on the beam from that source, and they carefully orient these transformers so the critical area of the beam path is in a magnetic null of the transformer field. On the other hand, if the scope is to be used around strong fields, a shield is a real necessity; furthermore, if the scope owner is a darned crank, as I cheerfully admit I am, who does not want *anything* influencing the motion of that spot except the signal fed into the amplifiers, a shield is worth its cost in personal satisfaction. For most applications the large outer shield would probably be adequate; but I thought while I was at it I might as well go whole hog and get the maximum attenuation provided by the double shield, since this only adds about twenty-five per-cent to the cost."

"I'd think scope shields would be a rather small market."

"Don't ever imagine magnetic shielding is used only on service and laboratory scopes," Mac exclaimed. "Magnetic shielding is becoming more important every day. Take tape recorders, for instance. On a tape deck in which the sensitive heads are mounted above the deck and the field-producing transformer and motor are mounted below, making the deck out of magnetic shielding material like this would establish a magnetic barrier between the fields and the heads. Recorded tapes stored in cans of this material would be safe from damage by magnetic fields. Radar equipment must be carefully shielded from magnetic fields if it is to be reliable. Airplane instruments containing magnets can be shielded so they may be mounted on the panel of the plane without affecting the compass.

"The salesman told about one interesting use of the material," Mac related. "Magnetrons have a terrific field, and when shipped by plane they formerly had to be stowed in the tail as far away from the sensitive instruments on the control panel as possible. Now, however, they can be encased in a double box of Fernetic Shielding and stowed wherever convenient without concern. What's more, since this shielding material does not retain any magnetism, the same shipping container can be used over and over.

"But probably a more important use lies in the aid this magnetic shielding material gives the modern trend to-

The most advanced developments in electronics are being made in the sphere of airborne radar and related ground control systems because of military emphasis.

Further applications of electromechanical techniques in these fields are creating new openings in the Systems Division of Hughes Research and Development Laboratories.

Engineers who have demonstrated ingenuity and inventive ability will find interest in areas of work that call for devising reliable, maintainable, manufacturable designs for precision equipment developed at Hughes Research and Development Laboratories.

The design of this equipment, manufactured at Hughes, involves mechanical, electromechanical, electronic, microwave and computing problems. Design also requires the use of such advanced techniques as subminiaturization, unitized "plug-in" construction, with emphasis on design for volume production. Knowledge of electronic components, materials, finishes and military specifications is useful.

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HUGHES

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ONE Generator covers 150 kc—435 mc!
WORLD'S BEST GENERATOR BUY!

New! EICO SIGNAL GENERATOR #324
KIT $26.95 Wired $39.95

- 6 fundamental bands: 150-400 kc, 400-1200 kc, 1.2-3.5 mc, 3.5-11 mc, 11-37 mc, 37-145 mc, 1 harmonic band 111-435 mc. Covers AM, FM, TV, & Amateur freqs.
- ±1.5% frequency accuracy; 6:1 vernier tuning knob & excellent spread at most important alignment frequencies.
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- Colpitts RF oscillator plate-modulated by cathode follower.
- Turret-mounted, slug-tuned coils.
- Fine & Coarse (3-step) RF attenuators; 50-ohm output Z.
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In stock at local parts distributors coast to coast.
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NEW folding platform attachment fits all YEATS dollies

carries TV models & chassis ends back breaking lifting & lugging!

Folds up when not in use!

Attached instantly, this ingenious new aid to TV and radio repairmen ends second story service problems when removing TV table models or chassis. With this new attachment, YEATS dolly users can use the dolly for chassis and table models as well as consoles . . . enjoy all the famous YEATS handling conveniences: 30 second strap ratchet fastening, caterpillar step glide and on-a-dime turning. Folding Platform is 13½" x 24", priced at $9.95. Call your YEATS dealer today!

SEND postcard for full information on our complete line TODAY!

YEATS appliance dolly sales co.
2101 N. 12th St. Milwaukee 5, Wis.

Hi-Fi record reproduction requires a PRECISION turntable...

THE NEW PRESTO Pirouette T-18

MADE BY THE WORLD'S LARGEST MAKER OF PRECISION RECORDING EQUIPMENT

- *Improves record performance tremendously*...delivers professional broadcast quality!
- *Simple operation*—a sideway flick of the control lever selects 3 speeds—33⅓, 45, 78 rpm.
- *Quiet insured!* Precision deep-well turntable bearing.
- *Quality plus!* Extra heavy weight, cast aluminum 12-inch turntable covered with non-slip cork.
- *Beautiful design*—smart telephone black and brushed chrome finish.
- *Easy to install*...only rectangular cut-out needed. Easy to buy at only $53.50.

Revolutionary 3-Speed Mechanism
The Pirouette embodies the exclusive PRESTO "flick shift" speed mechanism, with 3 idler wheels mounted on a single movable plate. Insures professional speed accuracy and trouble-free performance.

Presto Pirouette T-18H Turntable
The history-making T-18 with hysteresis motor...a magnificent hi-fi instrument. $108.

Presto Pirouette T-68 Turntable
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A 16" flick-shift turntable with hysteresis motor...a new pinnacle in hi-fi. $134.

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Rush catalog sheets on the new PRESTO Pirouette T-18, T-18H, T-68, T-68H turntables and name of nearest PRESTO distributor.
Name
Address
City Zone
State

ward more compact electronic equipment. Transformers encased in this material can be mounted side by side without coupling between them. No longer must we depend upon separation and careful orientation to prevent such coupling.

"But there's no point in my trying to list all the possible uses of magnetic shielding. Now, with magnetrons, magnetic amplifiers, and a whole host of similar magnetically-operated gadgets coming into daily use, it's of growing importance that we be able to confine the fields surrounding these pieces of equipment. That's why it seems almost like fate that this new lower-cost shielding material should appear on the scene just in the nick of time. And speaking of time, let's quit wasting it and get to work. If we get a bunch of these sets out in a hurry, I'll show you some tests I've worked out with this shielding stuff that'll make your eyeballs stick out like bubblegum bubbles!" —30—

D.C. HEATER SUPPLY

BY J. E. RICHARDSON

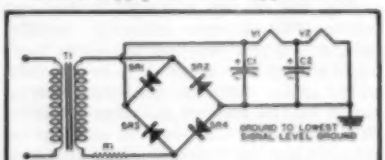
HUM FREE operation of the high gain preamplifier presents a tough problem. Those who want hum level down to that —90 db level eventually turn to a d.c. heater supply as the answer.

The d.c. supply shown in the diagram has been in operation for several months and has given excellent results. Prime consideration was given to constructing a supply that would give the desired performance without the large expenditure usually associated with d.c. heaters. The 24-volt transformer used was originally designed for TV antenna rotor controls. Both the transformer and rectifiers are available from some of the mail order houses for about three dollars.

The circuit is straightforward with the exception of the 500 μfd. capacitor between the first and second tube filaments. This eliminates the filter choke and provides extra filtering and decoupling to the low level phono preamplifier stage. The output from the supply is approximately 23.5 volts under the 150 milliampere load. The slight gain loss from operating the tubes at a lower filament voltage is more than compensated for by increased tube life and lower tube noise.

Owners of preamplifiers using more than two tubes will obtain excellent results by using this d.c. supply on the first two low-level stages. —30—

Schematic of a simple, inexpensive d.c. heater supply for audio applications.



R_1—10 ohm, 2 w. res.
C_1, C_2—500 μfd., 25 v. elec. capacitor
SR_1, SR_2, SR_3, SR_4—120 v. @ 150 ma. bridge selenium rectifier or two 120 volt @ 150 ma. full-wave selenium rectifiers connected to form bridge.
T_1—Trans., 24 volts @ 1 amp. (see text)
V_1, V_2—Any 12 volt, 150 ma. tube. (V_1 is phono preamp tube)

DYNAMOTORS:
A SWELL TRANS. & REC. MOBILE DEAL:

OUTPUT 625 VDC 225 MA.; Input 12 VDC. Size: 8" x 4¼" x 4" w/ Mtg. Plate & Jones Plug. DM-35—NEW: $12.95—Re-Issue: $8.95.

OUTPUT 220 VDC 80 MA; Input 12 VDC. Size: 4½" x 2¾" w/Filter Base Size: 6½" x 1¼" x 3". DM-34—NEW: $4.95—Re-Issue: $3.95.

COMBINATION DM-34 & DM-35:
NEW: $15.00 — RE-ISSUE: $10.00

HEAVY DUTY MOBILE DYNAMOTOR:

DM-42—14 V. Input; output 1030 VDC—280 MA. & 515 V. 215 MA. @ 6 VDC. Approx. half of Volt-Age.....NEW: $9.95—USED: $6.95

INPUT VOLTS:	OUTPUT: VOLTS:	MA.	STOCK No.	PRICES: USED:	NEW
14 VDC	330	180	BD-87	$3.95	$5.95
14	250	50	DM-25	6.95	8.95
14	1000	350	BD-77	14.95	20.95
14	500	500	BD-500		12.95
14	600	300	BD-86		12.95
28	1000	350	PE-73	8.95	
12 or 24	275	110	USA/0516		4.95
12	230	90	PE-133	4.95	6.95
14 VDC	375	150	BD-83	3.95	4.95
12 VDC	220	80	DM-34	2.50	4.95

ANTENNA EQUIPMENT

MAST BASES—INSULATED:

MP-22 BASE — (Illustrated) Ins. spring action; direction of bracket can be raised or lowered easily..... **$2.95**

MP-S-33 BASE—Insulated type with heavy coil spring and 5" dia. ins. Requires 2" hole for mounting. Weight: 9 lbs..... **$5.95**

MP-48 BASE—Insulated type base with heavy coil spring. Requires 1½" mounting hole. Weight: 11 lbs..... **$4.95**

MAST SECTIONS FOR ABOVE BASES:
Tubular steel, copper coated, painted in 3 ft. sections, screw-in type. MS-53 can be used to make any length with MS-52-51-50-49 for taper. Any section.....@ 50¢ Each
Larger Diameter Section: MS-54.....75¢

SOUND POWERED HEAD & CHEST SET

NAVY TYPE—No Batteries Required. Ideal for TV Antenna installations and many other uses. 20 Ft. Cord. Used and Tested....Ea. **$3.95**

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TRANSMITTER AND AUTOMATIC KEYER

T-121—3.5 to 4 MC; 50 Watt Crystal Control (Crystal in Novice Band); MO. P.A. for CW. W/2-1625, 1/25L6 Tubes & Crystal Keyer consists of 24 VDC Keyer Ass'y & Code Wheels. Size: 8½" x 8⅝" x 9½". W/Instruction Book. NEW: **$7.95**

METERS:

WESTON AC AMMETER:
(Pictured) In portable leather case, with Test Leads, 2½", 0-15 AC and 0-3 AC Scale..... **$5.95**

DC AMMETER HOYT: In portable metal case, with Test Leads, 4½", Fan Mirrored Scale 0-15 A. DC.....$4.95

NEW ITEM D B METER —10 to +6 Westinghouse 3" NC-35 Impedance 600 ohms @ 1000 cycle.....$4.95

0-3 RF AMMETER IS-128: 2½" Rd.....NEW: 2.95
0-8 Amp RF w/Thermocouple IS-89: 2½" Rd.... 4.95
0-15 AC-DC—2½" Rd.: IS-122..... 4.95
0-500 MA DC—2½" Rd.: IS-22..... 4.95
0-1 MA DC Simpson; 3½" Rd..... 3.95
0-2 MA DC Westinghouse; 3½" Rd..... 2.95
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0-150 V. 60 cycle; Simpson: 3½" Rd..... 3.95
0-250 MA DC—DeJur, 3" Sq..... 3.95
AUDIO OUTPUT METER—Portable, Five Ranges 0/1.5, 6, 15, 60, 150 Volts AC. Res.—4000 Ohms. Plastic Case P/O I-56 Test. NEW: $6.95—USED: $4.95

BC-221 FREQUENCY CASE

XMAS GIFT DEC. ONLY

ONLY **$1.50** WITH PURCHASE OF $10.00 OR MORE!

RECEIVER—TRANSMITTER
FM 20—28 MC.

BC-500 RECEIVER-TRANSMITTER:

FM Crystal Control on 5 Channels, 100 KC separation 20—28 MC. TRANSMITTER: 25 Watt output, 7 tubes: 1/1625, 1/12A6, 3/12BJ7; & 2/12BA7. RECEIVER: 11 Tubes: 1/12SL7, 2/12A6, 3/12BA7, 3/12H6, 2/12K8, & 1/12BJ7. DYNAMOTOR SUPPLY: Receiver 28 VDC 1.2 A. input; output 250 VDC 60 MA. Transmitter 28 VDC 4.1 A. input; output 550 V. 120 MA. CONTROL PANEL: For Local Control and outlets for Remote also. Heavy duty 5" speaker. Size: 12" x 25" x 9½". Weight: 65 lbs.
Price.....NEW: **$59.50**

BEACON RECEIVER

BC-1206 CM—200-400 KC., Setchell Carlson, operates from 24-28 VDC. 5 Tubes, 135 KC IF — Size: 4" x 4" x 6". NEW: **$9.95**

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COAXIAL CABLE: Price Per Ft.	100	500	1000
RG-8/U 51.5 Ohm (Special).....	.07	.06½	.06
RG-34 71 Ohms—145 Ft. Length.....$15.00 Per Lgth.			
RE Tractable Cord—3 Cond. #22, 10'.....Ea.: 4 1/$5.00			
CD-1071 CORD—With PL-259 Plugs each end, 50 ohm coax 2 Ft. long. Prices: 50¢ Each—Or in Lots of 10 @ 50¢ Ea.			

PL-259—Plug. Ea. End & 32"—RG-54 U—58 ohm.50¢
SO-239 Chassis Conn. 1/PL-259 (Removed)..3 for $1.00
UG-21/U—Plug on. end & 32"—RG-11/U—75 ohm.50¢
UG-22/U—With 4" Coaxial Cable.....50¢

BROADCAST RECEIVER

NAVY TYPE—620-1500 KC.
NEW.....$19.95
LIKE NEW.....$14.95
Q 5 er. NAVY TYPE—190-550 KC.....NEW: $12.95
R-28/ARC-5 REC.—100-156 MC. w/Tubes..USED: $10.95
NAVY TYPE COMM. TRANS.—2.1-3 MC. NEW: $7.95.....USED: $5.95
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(*Continued from page* 54)

As per usual, distortion is virtually nil, no pre- or post-echo, super wide range in frequency and dynamics. As with the previous issues, the packaging is deluxe with gold lamé album covers and beautiful colored illustrations depicting various scenes. It would be difficult to think of a more appropriate Christmas present for a balletomane friend or for the family, than this superb recording. Or better still (if the Christmas bonus turns out to be extra good) all three of the deluxe *Mercury* ballets! A bounty of ballet that size should satiate the most voracious musical appetites you are likely to have on your gifting list!

HAYDN
LORD NELSON MASS
Vienna State Opera Orchestra conducted by Mario Ross with Teresa Stich-Randall, soprano; Anton Dermota, tenor; Elizabeth Hoengen, alto; Frederick Guthrie, bass with Vienna Akademie Kammerchoir. Vanguard VRS 470. RIAA curve. Price $4.98.

Mario Rossi as a conductor of Haydn was a bit startling at first thought. By this I mean that his magnificent readings of Prokofiev and Stravinsky works were still fresh in memory and to say the least, this is repertoire of a different kidney! Any notions that a small label company was misusing talent were soon dispelled on listening to this recording. Admittedly, Mr. Rossi is not a Haydn scholar on the order of a MogensWoldike or Hermann Scherchen, but no excuses need be made for his reading of this thrilling work. In fact, there may be many who prefer his less pedantic, more liberal treatment of the score. Sure, his tempi are more hurried than is usual and his phrasing unorthodox, but neither does he stifle the essential drama of the work by clothing it in rigid and unyielding classicism.

Oldtimers in the field will remember that in the early days of LP, a virtual renaissance on Haydn "Masses" took place when the *Haydn Society* issued a spate of them. They were fairly good recordings for the time, but the discerning listener was well aware of their shortcomings. I think it can be said without much fear of contradiction that this present recording actually marks the first truly hi-fi recording of a Haydn "Mass." It is futile to expect that all the faults of the earlier recordings have been corrected . . . there is still some choral "blasting" and some chorai/orchestral "fusion". But by and large, this is a most commendable effort with superb balance, good spacious acoustics, exceptionally wide frequency and dynamic range and minimal groove distortion. To Mr. Rossi's good work must be added the first class performance of the vocal quartet. This group has far more luster than their earlier counterparts, and the Vienna Akademie Kammerchoir turns in their usual top notch job. To hi-fi newcomers we can only say this . . . give this music a fair trial. It is glorious, thrilling music by a master composer and irrespective of your particular religious affiliations, the work has a message that is universal in its appeal.

RIMSKY-KORSAKOV
SCHEHERAZADE
L'Orchestre de la Societe Des Concerts du Conservatoire de Paris conducted by Ernest Ansermet. London LL1162. RIAA curve. Price $3.98.

This being no less than the twentieth recording on LP, one might be forgiven for saying, "So what?" In spite of the redundancy, however, one cannot ignore the fact that this is by the formidable Ernest Anser-

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met, in a *London* recording calculated to squeeze the last db from the score. And believe me friends, this recording is hi-fi and no foolin'! It is interesting to compare this Ansermet reading with his earlier LP of some years ago. There are basic similarities, yes . . . but there are also many variations. Ansermet seems more deliberate in this version, seeming to strive for the utmost in orchestral definition. He certainly achieves this but in so doing, tends to roughen the smooth continuity of the score. Nevertheless, this must be reckoned as one of the very top readings available. To state that the hi-fi fans will have a field day with this one is a gross understatement! In *London's* best "big hall" manner, this is an astounding demonstration of orchestral brilliance and "liveness". I guarantee that the last movement will really make you sit up and take notice. There are few people who can resist the blandishments of this score and this recording would be a welcome item in almost anybody's Christmas stocking.

HINDEMITH
DIE HARMONIE DER WELT

Berlin Philharmonic Orchestra conducted by Paul Hindemith. Decca DL-9765. RIAA curve. Price $4.98.

This is one of those recordings that come along every once in a while, which from the word go, have the race "sewed up". For who can doubt the authority of the reading, as Hindemith himself is at the helm! Musically, the work is one of Hindemith's latest and a most interesting development. At least for the present he has abandoned his dabbling in baroque experimentation. This is a return to the sturdier Hindemith, of the "Symphony in E" and the "Mathis der Maler". The familiar heavy brass chordal effects are in evidence here and the over-all picture is that of a work which has strong overtones of a sort of quasi-mysticism combined with the usual rugged Hindemith orchestration.

There is atonality and dissonance here but I have always considered that, as used by Hindemith, these elements are easily assimilable. For those who have an inquisitive nature, I can assure you of a most interesting score. The Berlin Philharmonic responds superbly to Hindemith's urgings, and sound quality is excellent with generally clean string tone, good brass and percussion and splendid acoustics. I am happy to note that the quality of the *Decca* product has been on the rise for some time now. Unreservedly recommended to you lovers of the modern sound.

MODERN AMERICAN COMPOSERS (VOL. 1)

Soloists and chamber ensemble from the New Symphony Orchestra conducted by Camarata. London LL1213. RIAA curve. Price $3.98.

London has not previously delved into the complexities of modern music other than an occasional fling with Gershwin. This is the first of an announced series of recordings which will survey a good portion of the American musical scene. *London* gets off on the right foot with this dazzling disc of hi-fi pyrotechnics. Three comparatively obscure composers share honors on this disc, Robert McBride, Walter Mourant, and Ulysses Kay. In a potpourri of their works, Camarata shows off the fine precision of his hand-picked orchestra. Most interesting to me and an exciting little work which I am sure will find use as a demonstration piece is McBride's "Pumpkin Eaters Little Fugue". A set of variations on an old folk tune, this is productive of some fine toe-tappin' music. Also of note are Mourant's "Sleepy Hollow Suite" and Kay's "Round Dance and Polka". All are rather frothy, though not entirely insubstantial works, couched in typical modern aton-

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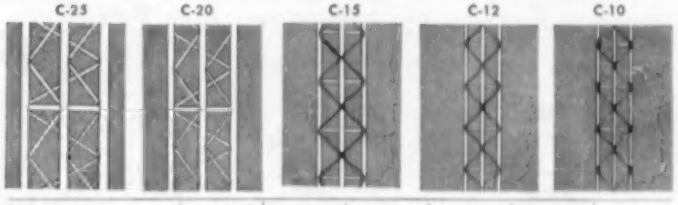

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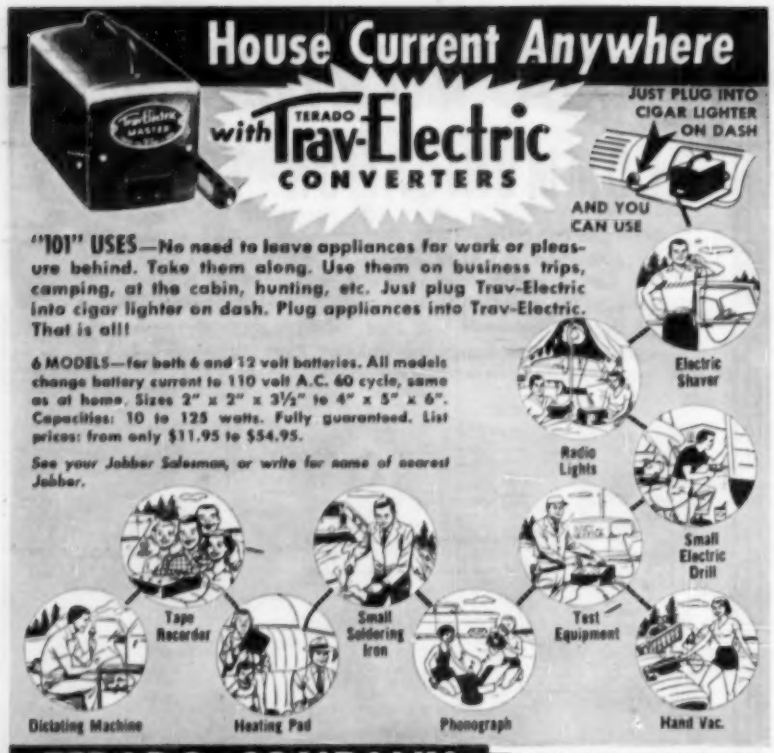
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ality with more than a smattering of the jazz element. The works are all pleasant enough but the real prize here is the terrific hi-fi sound. I would say the "Pumpkin Eaters Little Fugue" is as easy a way to introduce someone to the more spectacular aspects of hi-fi sound than any record which comes to mind. I might add this is excellent material for placating or indoctrinating wives to hi-fi. Nuff said!

BARANOVICH
THE GINGERBREAD HEART
Belgrade Philharmonic Orchestra conducted by Kreshimir Baçanovich. London LL1235. RIAA curve. Price $3.98.

It goes without saying that the composer of this work will be a talent new to practically everyone except the most erudite of musicologists. Be that as it may, this newest venture of *London* demands some attention. Ostensibly a "behind the iron curtain" orchestra, the Belgrade Philharmonic gives a fair account of itself. String tone is pretty lean and ensemble work in general was not up our own standards. However, the *London* technicians have managed to clothe the sound with the luster of their *ffrr* technique, which adds enjoyment of this delightful score immeasurably. While it would be unkind to call the music entirely derivative, it is certainly reminiscent of Stravinsky's "Petrouchka". With the light and frolicsome scoring, it is an interesting novelty and one wishes for the opportunity to see the ballet itself.

The flip side of the disc is occupied by another ballet suite in a somewhat darker mood, "The Devil in the Village" by Lhotka, who also conducts the work. I have no conception of whether the performances are good, bad, or indifferent, since the scores are totally unfamiliar (and unavailable), but since the composers are conducting their own works a high degree of authority should prevail.

Pop Corner

DAY DREAMS
Doris Day. Columbia CL624. RIAA curve. Price $3.98.

Doris Day is the kind of gal who you either dig . . . or you don't! There doesn't seem to be any in-between! For admirers of the lass, this will prove a bonanza, as she applies her uniquely personal way of singing in over 12 numbers. The collection includes many songs with which Doris has been closely associated, such as "You're My Thrill", "You Go to my Head", "Darn That Dream", etc. A variable disc in sound, some of the songs were undoubtedly recorded some time ago, while others have a liveness which would indicate they were hot from the presses. At any rate, *Columbia* has done a superb job of the Doris Day intimate close-up type of mike placement. In what seem to be more recent numbers, the characteristic Day breathiness and huskiness is captured with outstanding realism. First rate recording if you are acourtin' or just looking for some quiet background music to accompany that intimate dinner for two!

Tape Review

BRAHMS
CONCERTO FOR PIANO AND ORCHESTRA
Artur Rubenstein, pianist with Chicago Symphony Orchestra conducted by Fritz Reiner. RCA Victor monaural tape, half-track 7½ ips. Price $10.95.

Wellll . . . at long last!!! I have been promising you a review of the new *Victor* tape releases for months now, and the tapes finally arrived the other day, in time for this issue. This work was reviewed in its disc format some time ago, and my remarks then, are equally applicable here, with some plus factors. I stated in my review that I thought this was the best recorded piano concerto in

the LP catalogue. From all aspects, of Rubenstein's pianistic mastery, his and Reiner's wonderful rapport, and above all the fabulous sound, this stands above anything else we have yet heard in the field of the piano concerto.

On tape, the most immediately apparent difference was the considerably wider dynamic and frequency range. Add to this the heightened illusion of presence the still cleaner piano and orchestra affords. Tape hiss was almost at the vanishing point and the lack of scratches in vinylite and static induced "pops" and "clicks" added still further to the realism. Piano tone was of a brighter timbre and throughout the tape there was no evidence of ringing and no wow or flutter could be detected.

Victor evidently didn't do this concerto in stereo and it's a crying shame! Considering the repertoire, the stature of the artists, and the superb sound . . . a tag of $10.95 isn't too badly out of line. I think they can and will go lower on tape prices, if demand warrants the increased production that can bring about these reductions. Considering also that the tape can be played back almost ad infinitum with no increase in noise or loss of quality, the price is even less formidable. You can't go wrong on this tape. As played on a machine of good quality it is a most thrilling sonic experience.

STRAUSS, RICHARD
EIN HELDENLEBEN

Chicago Symphony Orchestra conducted by Fritz Reiner. RCA Victor stacked stereophonic tape, 7½ ips. Price $16.95.

It was most interesting reviewing this tape, because for one thing, it was the second to be made available by *Victor* in stereo format and I had available the new *Ampex* 612 tape machine for playback. Thus I had two items now commercially available which will open the door to stereophonic sound for thousands of people who heretofore felt that stereo was too rich for their blood. The *Ampex* 612 is a *playback* unit only. Approximately the same size as the *Ampex* 600 recorder, the versatile 612 will play 7½ ips tapes of all categories, *i.e.*, monaural half-track, monaural full-track, and stereophonic tapes.

With hysteresis motor the 612 can be obtained for a sum of $379.50, not pocket money to be sure, but a far cry from the $1000 plus outlay previously necessary. With a pair of *Ampex* 620 amplifier/speakers in a portable setup and the 612 similarly arranged, you actually have a complete stereophonic sound system of excellent quality, which you can take anywhere and for less than a $700 cash outlay.

Since the advent of the *Ampex* machine, many other record companies have decided to release some of their material on tape and supposedly some will announce the first releases as early as the Audio Fair. This "Heldenleben" was a fine performance and good sounding disc. In stereo, the totality of effect is staggering. *Victor* has wisely decided to make its first stereo releases of the Chicago Symphony, because of the fabulous acoustics of Orchestra Hall. Mike spacing was just a mite too wide in my opinion, but I am splitting hairs on this point. The Straussian masses of sound were a glorious thing to hear. Directionality was quite good, with the instruments sounding as if they were disposed properly in the normal concert arrangement. The depth perspective was particularly noticeable when both sides of the orchestra were playing together.

As with all stereo there was that super smooth edgeless string tone, the really crackling bright timbre of the brasses, and the incredibly clean percussion. Boys . . . this is it! The disc of the work, heard right after the tape, was almost dull. More stereo poop next month. —30—

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1705	2105	2375	2711	3010	3395	3702.5*	3895	4080	4305
1720	2106	2390	2732	3027.5	3412	3705*	3905	4085	4310
1770	2155	2395	2745	3077.5	3440	3710*	3920	4090	4325
1790	2175	2415	2764	3095	3462.5	3730*	3925	4095	4335
1810	2195	2422	2775	3117	2480	3745*	3935	4115	4345
1830	2202	2435	2776	3149	3485	3750*	3940	4130	4350
1850	2215	2446	2807	3155	3500	3765	3950	4135	4370
1870	2220	2466	2816	3161	3520	3770	3960	4150	4380
1890	2235	2478	2831	3190	3540	3775	3965	4155	4397.5
1910	2240	2491	2851	3201	3550	3790	3985	4175	4405
1930	2255	2514	2863	3270	3575	3792.5	3995	4177.5	4115
1950	2258	2540	2894	3278	3580	3807.5	4012.5	4182.5	4435
1970	2275	2586	2899	3280	3610	3825	4015	4210	4440
1990	2300	2587	2925	3311	3630	3830	4020	4215	
2010	2315	2605	2926	3317.5	3650	3850	4030	4235	
2030	2326	2625	2960	3345	3655	3855	4035	4240	
2050	2335	2643	2971	3365	3665	3870	4050	4255	
2075	2355	2645	2980	3385	3680	3895	4060	4275	

Price 50c Ea., 10 for $4.00
*80 Meter Crystals listed above, $1.50 ea.

370	390	410	430	449	460	486	508
372	392	412	432	451	470	488	510
374	394	414	434	453	471	490	512
376	396	416	436	454	473	492	514
378	398	418	438	456	475	494	516
380	399	420	440	458	477	496	518
382	400	422	442	460	479	498	520
384	402	424	444	462	480	502	
386	404	426	445	464	482	504	
388	406	428	447	466	484	506	

Each Frequency 25c ..... 6 for $1.00
500 KC. $1.00

B-7 COCKPIT LAMP
Use for Auto Map Lite or Instrument Light. Lamp socket attached to 5 foot retractable Lamp Cord. Unit enclosed in small Bakelite Case, measuring 3" x 3½" x 1" with On-Off Switch. All New ..... $1.50 Ea.

RF GENERATORS
20-40 MC—110 V. AC operated Voltage Regulated Supply. Use as signal generator or stable V.F.O. Has modulated or unmodulated output. Also has 400 Cy. Audio Output. ..... ALL NEW, in Wooden Case $39.95 Ea.

HEAD SETS
High Impedance H-14 Phones 8000 Ohm. For all standard Radio Output Circuits.
All New ..... $2.50 Ea.

VHF SIGNAL GENERATORS
Type 804 B. 7.5 MC. to 330 MC. in 5 Bands. 110 V., 60 Cy. operation. 20 Millivolts output. One of the finest generators made. Special Purchase permits this fantastic low price. ..... ALL NEW $75.00 Ea.

SPECIAL A.C. MOTORS
1/40 Horse Power Bodine Sync. Motor, 1800 R.P.M. Operates on 110 V., 60 Cy. Has 2 shafts and fan type flange mount. Uses 5 Mfd. capacitor for starting. Used for Fan, or small Grinder, Buffer or Hobby work. All in excellent condition.
Price ..... Ea. $7.95
Capacitor ..... Ea. $1.00

MIDGET SELSYNS
AY6 type operates from 6-12 Volts 60 Cycle. Use as both transmitter and receiver. These compact little units draw almost no current and work fine for all remote position indicating applications. OD 2¼ x 2¼ x 2". Has spring return shaft.
All New (Appr. wt. 1 lb.) ..... Ea. $1.50

WILLARD 2 VOLT BATTERY
NEW, Dry Charged (Appr. wt. 4 lbs.) TYPE 20-2, 20 Amp. hour
Each $1.95

2 Volt VIBRATORS. VR8A Synchronous Type. Used in all portable radios having 2 volt wet cell supply. All new ..... ea. 50c

12 VOLT DYNAMOTOR

PE-55 Power Pack. Complete New Unit with DM-19 Dynamotor, Filter and Relay Base. Continuous Ratings, 500 V. @ 200 MA output or intermittent 500 V. @ 400 MA. These are all NEW in original cases ..... $14.95 Ea.
Output Cable for above dynamotor ..... $1.50 Ea.

SOUND POWER PHONES

Use these phones without any external or internal voltage supply. Two or more can be used with only 2 wires interconnecting them. Use for TV installation, house to house or house to garage.
All New ..... Per Pair $19.95

All Mail Orders Promptly Filled, F.O.B., San Francisco . . . All California Orders—Add 3% Sales Tax . . . Do not send postage stamps. 20% Dep. on all C.O.D. orders. All items subject to prior sale and prices subject to change without notice. ON PURCHASES UNDER $5.00 SEND FULL AMOUNT.

STANDARD SURPLUS
1230 Market St., San Francisco 3, Cal.
Telephone HEmlock 1-3106

Have you got the

'B-T Blues?'

If you're a high-fidelity fan, then you undoubtedly suffer from the B-T Blues.

You want to hear a record as it was originally recorded . . . so you set the equalization control on your amplifier to the curve at which the record was made . . . and then you're stuck! The record doesn't sound quite right to you, because the acoustics of your room are different from those of the studio, or perhaps your individual taste requires a little less highs—or a little more lows.

Now you have to adjust the bass and treble controls to get the kind of reproduction you want, and, because they're not calibrated, you have to readjust them every time you play the same record — that's the B-T Blues.

The Munston Maestro, with 'Dynamic B-T' (Bass-Treble), does away with the B-T Blues! Dynamic B-T gives you separate turnover and rolloff settings distinctly marked on the bass and treble controls, respectively, for all of the latest equalization curves. Both controls are also completely calibrated through their entire range, so that if it is necessary to adjust the controls after the equalization setting has been made, it is a simple matter to note on the record the exact setting of the controls which pleases you best, for future reference.

munston

10-watt Amplifier with Built-in Preamp — Maestro

$79.50

See the Munston Maestro at your local Hi-Fi dealer's, or write for complete information.

MUNSTON MANUFACTURING, INC.

Beech Street, Islip, L.I., N.Y.

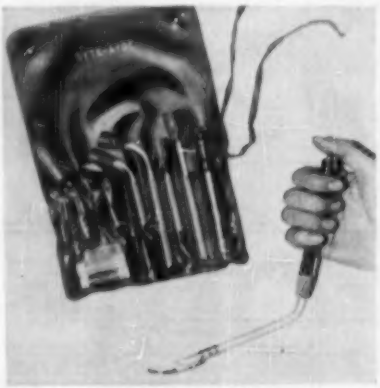
What's New in Radio

INSPECTION LIGHT

A new multi-purpose inspection light which is designed to permit the inspection of otherwise inaccessible or hard-to-see areas, bends light around corners by means of a combination light-focusing rod and magnifying mirror, has been announced by the *F. T. S. Corporation*, 309 Vine Street, Camden 2, N. J. as its "Syte-Ayde."

Light for the unit is provided by a pen-sized flashlight. A detachable lucite rod transmits and focuses the light on the area being inspected. Easy viewing of the area is then possible through a magnifying mirror attached to the rod end.

The complete kit contains a flashlight with lock switch, two batteries and bulb, four detachable lucite rods (two straight and two angled), and



three detachable angle-form mirrors. A compartmented pocket-sized plastic case holds all of the items.

Complete details on this kit are available by writing George W. Powell, president of the firm.

PC PROTECTION

General Cement Mfg. Co., 919 Taylor Avenue, Rockford, Illinois has developed a new silicone resin for protecting printed circuits after they have been repaired by the technician.

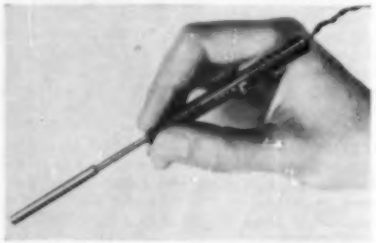
Tradenamed "Print-Kote," the new product comes in a convenient pressure spray can for easy application. It will insulate a printed circuit effectively, preventing arcing and shorting without further attention. After repairing or replacing parts in a printed circuit, the technician simply spray-coats the soldered connections with the liquid.

Further information and literature are available from the company.

MINIATURE SOLDERING TOOL

Television Accessories Co., 1412 Great Northern Bldg., Chicago 4, Illinois is handling the U. S. distribution of a new miniature soldering tool, the "Oryx" Model 11.

Weighing less than ¼ ounce, and measuring 6 inches long, the tool is de-



signed for production and laboratory engineers, technicians, and experimenters who solder for long periods of time.

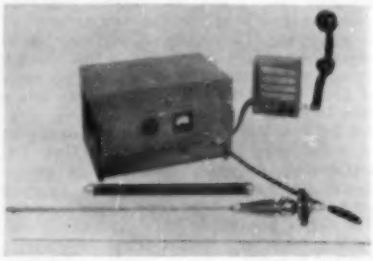
The tool takes only a minute to heat and is equipped with a 5/32" pure nickel non-corrosive tip, which can be easily replaced if necessary. The distributor will supply full details on request.

MOBILE TRANSCEIVER

The *Allied Engineering Division* of *Allied International Inc.*, Connecticut and Richards Aves., South Norwalk, Conn. has designed a mobile transceiver and companion control unit for trouble free service under difficult operation conditions.

Especially suited for use in desert climate, this equipment is ruggedly made to withstand mechanical shock and reduce maintenance. All components have been designed for extra heavy duty.

The Type 502 transceiver operates on fixed crystal-controlled frequencies of 2870 kc. and 5740 kc. Sensitivity is 1 microvolt on each frequency. Also incorporated in this unit are a noise limiter circuit to eliminate interference and ignition noise and a squelch



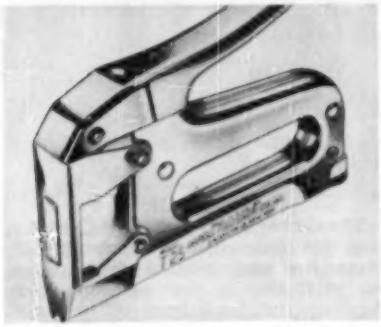
circuit to quiet the receiver during standby.

The transmitter requires 6 or 12 volts d.c. with positive ground. Current drain is 58 amperes maximum. Power output is 40 watts. Supplied in a single integrated package, ready for

installation are: transceiver and control units, headset and bracket, antenna with universal mount and two loading coils, three 15-foot lengths of 2-conductor, 6-conductor, and 52-ohm coax with connectors, a bypass capacitor, and a 60 amp fuse and holder.

STAPLING GUN

Arrow Fastener Co., Inc., 1 Junious Street, Brooklyn 12, New York has developed a new staple gun, the T-25,



for fastening low-voltage wires automatically, safely, and without danger of short circuits or wire damage.

The T-25 is designed for one-hand operation, leaving the other hand free to keep balance on ladders, etc. To prevent short circuits or damaged wires, the staple is stopped automatically at the right height. The staple fits tightly because of its round crown that will not cut sheathing or insulation. The unit has a tapered striking edge which permits the device to be used to fasten wire in tight corners.

Staples for use with the T-25 come in 7/16" and 9/16" leg sizes for various applications. The staples will grip in hard woods, plaster, etc.

SILICON RECTIFIERS

Westinghouse Electric Corporation's Semiconductor Department, 356 Collins Avenue, Pittsburgh 6, Pa. has announced the availability of a new line of silicon rectifiers capable of handling up to several kilowatts of power.

The new diodes have a typical forward voltage drop of only .7 volt at a current of 8 amperes and at a cell temperature of 190 degrees C. When mounted in a finned case one inch high and one and a half inches in diameter, this unit has a rating of 15 amperes at 200 volts peak inverse. This is with natural convection cooling in a 65 degree C ambient temperature.

At present, four voltage classifications are available: 50, 100, 150, and 200 volts. Write the company for detailed information on these units.

SLIP SOCKETS

Techron, Incorporated, 254 Friend Street, Boston, Mass. is in production on its "Micro-Pin Socket" which makes possible solderless connection of diodes, transistors, and other components, especially in printed circuit applications.

(*Continued on page* 146)

To Demonstrate Our Hi-Fidelity Opera Recordings

CARMEN FOR $1

SEND NO MONEY! NO STRINGS ATTACHED!

Audition this exciting production *free* for 5 days in your own home. If you like it send only $1 as payment in full or return it and pay nothing. There is no obligation to buy another record from the Society ever.

You'll hear every famous aria, duet, chorus, overture—a breathtaking performance by an internationally famous operatic cast, with the *Netherlands Philharmonic* conducted by Walter Goehr . . . excitingly brought to life through custom high fidelity recording techniques. And this offer will introduce you to our generous membership plan giving you many privileges, yet *no obligations*. You may have for *free home trial* magnificent 12" long playing discs of your choice—performed by world renowned artists—and pay only $2.95 each if you keep them. *A saving of over 50% off the usual retail cost.* Send coupon *without money* now!

The Opera Society, Dept. 14-RY
48 Columbus Avenue, New York 23, N. Y.

Rush 12" long play recording of CARMEN for free audition. Enroll me as a Trial Member. After 5 days I will return it or send only $1 plus shipping. Privileges: No purchase obligation ever! Advance notice of releases. 5 days free trial on any discs. May reject records before or after receipt. May cancel membership at any time. For future 12" long-playing discs I keep, I'll pay only $2.95 each, plus a few cents for shipping.

LIMIT: Only one introductory album per customer.

Name .....
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Canada: 105 Bond St., Toronto, Ont.

FREE COUPON for exciting gifts for every dollar you spend. Electrical appliances, etc. for use in home, sale over counter. Send for **FREE PREMIUM CATALOG** . . . order now . . . start collecting these valuable coupons!

FREE GIFT COUPONS

- 900,000 Radio & TV Tubes
- Individually boxed
- One year RTMA guarantee
- Same day service

Stanley boasts the very best brands individually boxed in attractive Stanley boxes. Quality is guaranteed. Check others, see if Stanley's prices aren't the lowest!

TUBE SPECIALS

Till Jan. 1st

29¢ each

1A4P	6S7
1J6GT	7E5
3D6	12JSG
6K7	35/51
6J5	

Disregard Main Tube List!

SAVE BIG MONEY AT STANLEY ON TUBES

TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE
0Z4	.45	6A8S	.50	6907	.90	12SN7	.47
1B3GT	.79	6A8G	2.00	6907	.43	12SJ7GT	.60
1L4	.56	6A57G	2.25	6SN7	.45	12SK7	.60
1L6	.60	6AT6	.40	6SJ7GT	.45	12SL7GT	.69
1LA4	.66	6AU6GT	.70	6SK7	.50	12SN7GT	.60
1LB4	.66	6AU6	.46	6SL7GT	.70	12SQ7GT	.44
1LC6	.66	6AV6GT	.82	6SN7GT	.60	14A5	.59
1LD5	.66	6AX5GT	.59	6SQ7GT	.44	14A7	.46
1LE3	.66	6B4G	.90	6V6GT	.46	14B6	.40
1LG5	.66	6BA6	.49	6W4GT	.40	14Q7	.52
1LH4	.66	6BC5	.55	6W6	.60	19BG6G	1.16
1LN5	.49	6BE6	.50	6W6GT	.66	19J6	.66
1N5GT	.55	6BG6G	1.16	6X4	.35	19T8	.70
1R4	.66	6BH6	.61	6X5	.39	25A7GT	1.50
1R5	.67	6BJ6	.49	6X5GT	.35	25AV5GT	.80
1S4	.65	6BK5	.70	6X8	.75	25B5S	.96
1S5	.65	6BK7A	.78	6Y6G	.63	25BQ6GT	.90
1T4	.65	6BN6	.59	7A4-XXL	.47	25Y5	.46
1U5	.80	6BL7GT	.77	7A5	.55	25Z5	.38
1V	.67	6BQ6GT	.65	7A6	.47	25ZE6T	.42
1X2A	.79	6BQ7A	.80	7A7	.45	35A5	.46
2D21	1.00	6BZ7	.90	7A8	.46	35B5	.52
2V3G	.80	6BY5G	.80	7B5	.41	35C5	.51
3X2A	1.00	6C4	.39	7B7	.43	35L6GT	.48
3D6	.45	6C5	.35	7B8	.47	35W4	.39
3LF4	.80	6C6	.80	7C4	.40	35Y4	.40
3Q4	.62	6C9G	.55	7C5	.44	35Z3	.41
3Q5GT	.63	6C9GG	1.16	7C6	.45	35Z5GT	.39
3V4	.65	6D6	.80	7F7	.70	50B5	.52
5T4	.70	6E5	.46	7F8	.70	50C5	.51
5U4G	.40	6F6	.40	7Y4	.35	50L6	.48
5V4G	.71	6H6GT	.40	12AT6	.46	50L6GT	.45
5Y3GT	.39	6J4	2.00	12AT7	.68	70	.44
5Y4G	.43	6J5GT	.40	12AU6	.46	77	.39
5Z3	.47	6J6	.49	12AU7	.80	78	.39
5Z4	.54	6J7	.45	12AV6	.46	80	.35
6A7	.59	6K7	.40	12AX7	.70	83V	.60
6A8	.89	6K8GT	.59	12AY7	.90	117L7GT	2.00
6AB4	.48	6L7	.44	12BA6	.48	117N7GT	2.00
6AF4	.80	6N7	.61	1284	.70	117P7GT	2.00
6AG5	.56	6Q7	.45	12BE6	.50	117Z3	.37
6AH6	.80	6S4	.48	12BH7	.70	1172GT	.66
6AK5	.80	6S7G	.47	12BY7	.68		
6AL5	.44	6SA7GT	.60	12SA7	.52		
6AL7GT	.70						

PARTS SPECIALS—Till Jan. 1st

WELLER DUAL-LITE SOLDER GUN KIT

100 watt gun provides the proper heat for most applications. Dual spotlight illuminates work. Kit includes Gun, wire soldering brush, soldering aid, Kester solder..... **$5.83**

Pocket AC-DC MULTITESTER $9.45 Lots of 3

Hi-accuracy precision VOM-1000 Ohms per V. Reads AC & DC volts 0, 5, 25, 250, 1000 V. DCMA: 0.1, 10, 100MA. Ohms 0, 1, 10, 100K. Size: 3¼ D, 4⅝ L, 3¼ W. Test Leads. Sold singly **$5.95**

SHELDON PICTURE TUBE BRIGHTENER $1.19 ea. Lots of 3, **$1.09**

TV and Radio Controls
5K—50K—100K—200K—500K, 1 meg, less switch. Your choice, ea. 19¢
With switch, long shaft, ½ meg—1 meg..... ea. 39¢

70° Cosine Yokes
TV deflection yoke. New type for anti-anastigmatic focusing. With leads. List $10.30..... ea. **$ 2.99**

Standard Coil CASCODE TV TUNERS
Long shaft, 41 MC, complete with 6J6, 6BQ7. 12 channel (2 to 13)..... ea. **$13.95**

UNIVERSAL 4-Prong Auto Radio Vibrator
For 90% of 6 volt auto sets. $1.39 ea. Lots of 10, ea. **$ 1.29**

KNOB KIT
25 asstd. knobs for radio, TV, auto work. Each kit **$ .89**

GE TYPE FLYBACK TRANSFORMER
14.5 KV Flyback, use with 6BG6 or 6CD6..... ea. **$ 2.49**
12 to 14.5 KV..... ea. **$ 2.49**

6 FT. EXTENSION CORD
UL approved. Molded rubber plug. 22¢ ea. Lots of 5, ea. **$ .19**

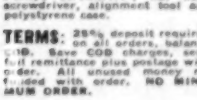
VISULITE TV TUBE CHECKER AND CONTINUITY TESTER
Automatically checks all tubes, tests electrical devices such as fuses, lamps, resistors, etc..... ea. **$ 3.85**

TUBE SOCKET KIT
25 asst. octal, loctal, 7 pin, 9 pin miniature in bakelite and wafer type. Complete..... ea. kit. **$ .89**

TERMINAL STRIP KIT
10 asst. most wanted type for radio, TV. Complete..... ea. kit. **$ .59**

SPEAKERS—TERRIFIC SAVINGS!

4" PM	Matching output transformer	$1.57
5" PM	AC-DC sets. Intercoms. $1.79 ea.	Lots of 10, ea. $1.59
6" PM	Powerful magnet. $2.29 ea.	Lots of 10, ea. $2.00
8" PM	For radios, small PA systems. $3.49 ea.	Lots of 10, ea. $3.29
10" PM	Excellent fidelity. $3.95 ea.	Lots of 10, ea. $3.75



FREE with each $25 or more order! 6-Pc. Sylvania Repair Kit. Value $4.95. Includes: Flashlight head, Philips screwdriver, flat head screwdriver, alignment tool and polystyrene case.

TERMS: 25% deposit required on all orders, balance C.O.D. Save COD charges, send full remittance plus postage with order. All unused money refunded with order. NO MINIMUM ORDER.

SEND FOR PARTS AND TUBE LISTING

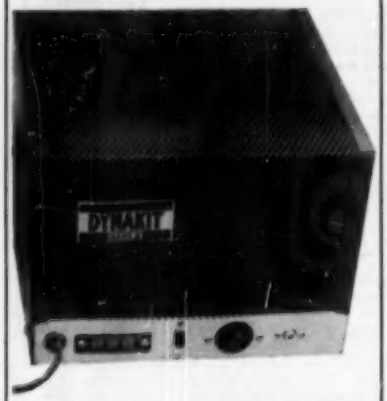
FREE with $3 order or more!
Practical, All-Purpose ELECTRIC TESTER
Equipped with genuine GE neon glow lamp. Tests leaks from 90 volts to 500 volts, AC or DC. Use it in the home, factory, shop, garage, etc.

Stanley ELECTRONICS CORP.
935 MAIN AVENUE - PASSAIC, N. J.
Dept. RH-12 Gregory 1-2400

DYNAKIT

Mark II

50 WATT POWER AMPLIFIER KIT



BEST IN EVERY WAY

✓ **FINEST QUALITY**

New circuit designed by David Hafler using the Dynaco A-430 output transformer, the finest available, to provide outstanding transient response and lowest distortion.

✓ **EASIEST TO ASSEMBLE**

Simple arrangement with unique physical construction for accurate reproducibility of the kit's superb characteristics.

✓ **MOST COMPACT**

Only 9" x 9" x 6¾" high without sacrifice of performance.

✓ **HIGHEST POWER**

50 watts at less than 1% IM for listening ease.

✓ **GREATEST VALUE**

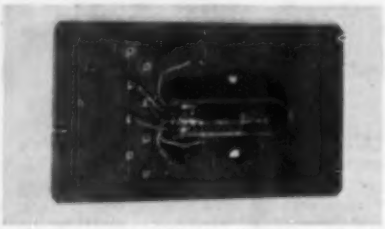
Only $69.75 with quality unequalled at any price.

Complete specifications on this new amplifier kit are available on request

DYNA COMPANY

8142 MASTER ST. PHILADELPHIA 31, PA.

The "Micro-Pin Socket" is a spring-backed, plug-in socket made of copper alloy. Its outer shell is approximately



.2" long and .08" in diameter. It is press-fitted and dip soldered into the circuit board. The diameter of the socket is such that the receiving hole in the circuit board can be either punched or drilled. Press-fitting can be done without the use of any special tool. The spring inside the socket is flexible enough to permit repetitive plug-in-and-out operations, yet strong enough to hold the lead with a retaining force of several ounces.

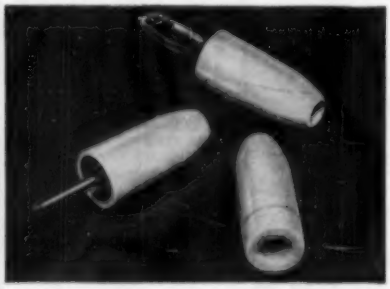
Write George Ganjian, sales manager of the firm, for information on the available sizes.

INSULATED CONNECTORS

Three new miniature nylon-insulated connectors have been introduced by *E. F. Johnson Company* of Waseca, Minnesota for applications where durability and high-voltage insulation are important.

Shockproof and extremely rugged, the nylon insulation handles are unaffected by most chemicals and will withstand extremes of temperature and humidity without loss of mechanical or electrical efficiency. Each type is available in eleven colors for coding applications.

The tip and banana plugs are designed for solderless connection of up



to 16 gauge stranded wire. The nylon tip jack and insulating sleeve assembly is an adaptation of the firm's nylon tip jack equipped with an inside threaded nylon insulating sleeve. Designed for patch cord use, the unit will also serve as a panel mounted jack where the rear connection must be insulated.

HOT TUBE PULLER

Hunter Tool Co., 6608 S. Gretna Ave., Whittier, California has added a new "hot tube puller" to its line of servicing accessories.

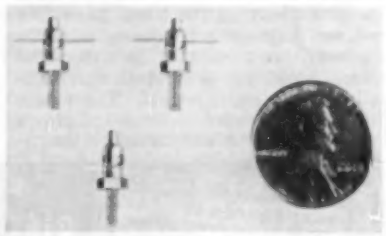
Built in two models, one straight and one bent at a 90 degree angle, the tube puller is designed to remove hot tubes safely and rapidly. The tool is easy to operate since it merely clamps

over the tube which is then lifted up and out.

DIODE CLIPS

The Cambridge Thermionic Corporation, 445 Concord Ave., Cambridge 38, Mass. has announced a new spring-loaded diode clip that securely holds fragile pigtail leads from .005" to .035" in diameter.

The clip is made of brass and is finished in .0002" bright alloy plate. When mounted it is 11/32" in over-all



height. The mounting stud is 7/32" long, hexagonal with a 2-56 threaded stud.

For further specifications and additional details, write the manufacturer direct.

H.F. TRANSISTORS

General Transistor Corp., Jamaica, N. Y. is now delivering its new high frequency GT-760 series of *p-n-p* junction transistors.

Designed for high-frequency operation as r.f. and i.f. amplifiers in broadcast receivers and as switches for high speed computer applications, the GT-760, GT-761, and GT-762 have *alpha* cut-offs of 5 mc., 10 mc., and 20 mc., respectively.

The transistors are double sealed, first encapsulated in plastic and then hermetically sealed in a can.

CERAMIC TUBES

Eitel-McCullough, Inc., pioneer transmitting tube manufacturer of San Bruno, Calif., has entered the receiving tube field with a ceramic unit which is revolutionary both in design and circuit adaptation.

According to the company, the tube is much more rugged and less than one-fourth the size of a comparable glass tube with the same electrical characteristics. Sockets common to

existing tubes are eliminated. Predicted life expectancy of the tube is such that it can be soldered in its standard type wire circuitry or printed circuit module.

The Model CD-16 is ideal for mobile and airborne applications. It is highly

immune to damage from thermal and physical shock. Vibration testing has shown it to be twenty times as rugged as its glass counterpart, the 6SN7.

PRINTED CIRCUIT "EDU-KIT"

Progressive "Edu-Kits" Inc., 497 Union Avenue, Brooklyn 11, New York has come out with a 1956 model of its "Edu-Kit" which incorporates printed circuitry.

The new kit includes the printed circuitry and all the necessary materials and instructions for building sixteen different radio circuits, including a newly designed signal injector, signal tracer, receivers, transmitter, and code oscillator.

In addition to including all the parts for building the circuits, the kit comes with a soldering iron, a tester, and other "extras." Free literature and radio-TV servicing manuals are available upon request to the company at Room 400E, Progressive Building at the Brooklyn address.

U.H.F. CONVERTER

Elgin Electronic Corporation, P. O. Box 13, Bluffton, Indiana is now offering a new deluxe version of the u.h.f. converter which has been designated as the Model 210.

Housed in a wood cabinet in either mahogany or walnut finishes, the converter offers continuous tuning. It features a stable oscillator circuit and

uses a 6AF4A tube and 1N71 germanium diode. The input circuit is of the "no-loss" type. Operation is from 110 volts a.c.

TRANSISTOR CAPACITOR

Glenco Corporation, 212 Durham Ave., Metuchen, N. J. is now offering a new series of low-voltage capacitors designed for use in transistorized circuits for bypass and coupling applications.

Full details on the "Ceramistor" line are available from L. C. Oakley of the company. —30—

TRANSISTOR CODE PRACTICE OSCILLATOR

ANYONE who wishes to obtain an amateur license will find it necessary to learn and practice the International Morse Code. For those prospective amateurs who desire to learn the code, here is a compact, transistorized, self-powered, low-cost, keyed audio oscillator that will more than serve the purpose.

The circuit of this transistorized feedback oscillator, see Fig. 1, has the simplicity of a neon glow unit but the signal strength of the vacuum-tube type. Operation is effected by means of two penlite cells which will provide weeks of service.

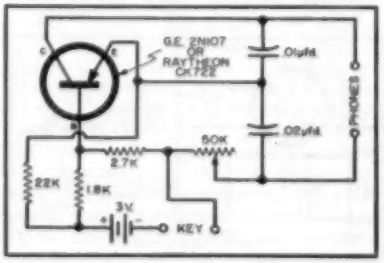
The oscillator may be used for solo practice or two may send and receive with the same unit. As shown in the circuit diagram, a potentiometer is used to provide a means of adjusting the audio frequency to the desired pitch.

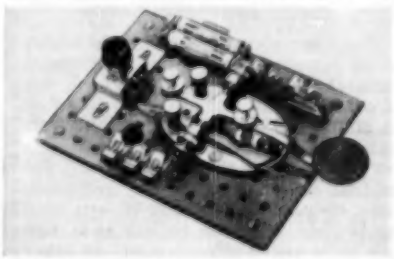
A complete set of parts, including the transistor, key, resistors, capacitors, etc. is available in kit form (Model KT-72) from Lafayette Radio, 100 Sixth Avenue, New York 13, N. Y., for $2.99. The key is a standard type used by the Armed Forces and can be adjusted for spring tension and gap. The shorting switch bar is left open for practice purposes, but can be closed to provide a continuous tone for adjustment or test purposes.

The headset (not supplied with the kit) should be of the 2000 ohm d.c. magnetic type.

—30—

Fig. 1. Schematic of the code practice oscillator and photo of assembled unit.





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FT-243 fundamental frequencies

80 METERS	40 METERS
3701 to 3748 kc in 1 kc steps	7150 to 7200 kc in 1 kc steps

FT-243 FUNDAMENTAL FREQUENCIES 50 c

7910	3965	4095	5906.7	6350	6800	7225	7650	8075
7915	3970	4135	5940	6373.3	6806.7	7240	7673.7	8100
7920	3975	4175	5958	6375	6825	7250	7675	8106.7
7925	3980	4215	5973.3	6400	6840	7273.7	7700	8125
7930	3985	4255	5975	6406.7	6850	7275	7706.7	8140
7935	3990	4295	6000	6425	6873.3	7300	7725	8150
7940	3100	4445	6006.7	6440	6875	7306.7	7740	8173.7
7945	3105	4450	6025	6450	6900	7325	7750	8175
7950	3110	4845	6040	6473.3	6906.7	7340	7773.7	8200
7955	3115	5305	6050	6475	6925	7350	7775	8206.7
7960	3120	5567.5	6073.3	6500	6940	7373.3	7800	8225
7965	3125	5675	6075	6506.7	6950	7375	7806.3	8240
7970	3130	5700	6100	6525	6973.3	7400	7825	8250
7975	3135	5725	6106.7	6540	6975	7406.7	7840	8273.3
7985	3140	5740	6125	6550	7000	7425	7873.7	8275
7990	3145	5750	6140	6573.3	7006.7	7440	7850	8300
7995	3150	5773	6150	6575	7025	7450	7875	8325
8000	3155	5775	6173.3	6600	7040	7473.7	7900	8350
8002	3160	5800	6175	6606.7	7050	7475	7906.7	8375
8010	3165	5806	6200	6625	7073.3	7500	7925	8400
8015	3170	5825	6206.7	6640	7075	7506.7	7940	8425
8020	3175	5840	6225	6650	7100	7525	7950	8450
8025	3180	5850	6240	6673.3	7106.7	7540	7973.7	8475
8030	3185	5873.3	6250	6675	7125	7550	7975	8500
8035	3190	5875	6273.3	6700	7140	7573.7	8000	8525
8040	3195	5900	6275	6706.7	7150	7575	8006.7	8550
8045	3895		6300	6725	7173.3	7600	8025	8575
8050	3900		6306.7	6740	7175	7606.7	8040	8600
8055	3825		6325	6773.3	7200	7625	8050	8625
8060	4045		6340	6775	7206.7	7640	8073.3	8650

SINGLE SIDE BAND—FT-241-A

440	442	446	450	453	456	459	463	466	470	474	477
440	444	447	451	454	457	461	464	468	472	475	478
441	445	448	452	455	458	462	465	469	473	476	480

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Improve Your Signal Generator

By **JAMES V. CAVASENO**

Make certain that your radio and TV alignments are accurate. Add this simple circuit to your generator.

MANY signal generators used in average service shops are not as trustworthy as they should be. Often, after a TV set is "aligned" with such an instrument, the technician finds that the set still seems to need alignment. The reason for this is that the i.f.'s were aligned at the wrong frequencies, due to the inaccuracy of the signal generator.

The circuit to be described in this article, added to any existing generator, will make it extremely accurate. This circuit is a crystal oscillator which is very simple to install in any signal generator; the parts required are few. The oscillator generates a very accurate signal whose frequency is known, against which the dial of the signal generator can be calibrated.

To get on with the actual construction, first mount a 7-pin miniature tube socket in a convenient place on the signal generator chassis and wire it up as shown in Fig. 1. One side of the mica trimmer, C_1, is soldered to the chassis as this will serve to support it. The r.f. choke in the plate circuit may be a peaking coil of about 400 or 500 microhenrys, or it may be one-half of a radio i.f. coil, that is, one of the coils found in the can of a high-impedance type i.f. transformer. If a peaking coil is used, make certain it isn't one that has a resistor across it.

The crystals used may be found in the surplus market or obtained at an electronic parts distributor. Only one is needed, but an "assortment" would be more desirable. The most usable single crystal is a 450 kc. one, since it will give an accurate signal at 450 kc. for radio alignment, at 4.5 mc. for TV sound alignment, at 9 mc. for FM (the FM i.f. is 10.7 mc.) and 22.5 mc. for the TV i.f.'s. Since any signal generator will give an output not only of the frequency to which it is tuned, but also harmonics of that signal, the idea of using the circuit of Fig. 1 is to beat the crystal oscillator's harmonics against those of the signal generator and, measuring the combined output of the two, adjust the signal generator for a null reading.

For example, using a crystal which gives signals every 5 mc., the signal generator dial may point to 21 mc. for a null reading. Actually then, the dial is off one whole megacycle, since the generator is tuned to 20 mc., which is an exact harmonic of the 5-mc. crystal oscillator. Now either the generator may be adjusted so that it will read accurately, or it can be left as is, and the error taken into account. In other words, whatever error you find when checking your generator must be added to the frequency indicated by the pointer to get the correct reading. In the event that the generator reads too high, it will be necessary to subtract instead of add the error.

Don't assume that once the generator is adjusted it will read correctly from then on. Variations in line voltage from day to day, and differences in temperature on the parts in the generator, will cause it to read incorrectly from time to time. Therefore, it should be checked each time it is to be used. Using the calibrator described here makes it a simple matter.

In order to save time when using the crystals, it is a good idea to mark each one with its harmonics. A crystal bought on the surplus market will usually not generate an even frequency. Instead of a 5 mc. crystal, for example, the one obtained from surplus will probably be something like a 5.456 mc. one. This crystal will put out signals at that frequency, plus others at 2 times that, which is 10.912 mc., 3 times that, which is 16.368 mc., and 4 times that, which is 21.824 mc., etc. Just write down these numbers on a small piece of paper and attach it to the crystal for quick reference.

There is only one adjustment that has to be made after the crystal calibrator is assembled. The voltage on pin six, the grid, will be negative if the circuit is put together correctly. Adjust the trimmer, C_1, for the highest voltage. Then, remove the crystal for a second, and plug it back in, measuring the grid voltage to see if the circuit starts to oscillate again. If it does, fine, if it doesn't, turn the trimmer screw back a little and try the pull-out test again. This should be repeated to obtain the highest voltage on the grid that will still allow the circuit to oscillate when a crystal is inserted. —30—

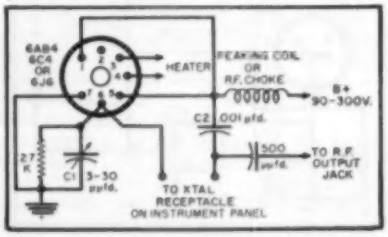

Fig. 1. Complete schematic diagram of the crystal oscillator circuit to be added to any signal generator for calibration purposes. Either one of the three tubes shown will work correctly.

Phonograph Evolution

(*Continued from page 57*)

material refers specifically to the sections of the patent.

"Fig. 1 is a perspective view of my recording and reproducing apparatus; Fig. 2, a like view of the recording and reproducing diaphragm with its stylus; Fig. 3, a similar view of a portion of the support for the record-surface; Fig. 4, the same view with the record-surface applied; Fig. 5, a plan view of a phonautographic record; Fig. 6, perspective of a phonautographic record copied in solid resisting material; and Fig. 7, the copied record mounted, ready for application to the support.

"The general arrangement of the parts is best illustrated in Fig. 1, in which a T-shaped baseplate, *A*, is shown, upon which two standards, *H*, *I*, serving as journal-bearings for the shaft of drum *G*, are mounted. The drum *G* may be constructed with flanges *ec'*, which project beyond the cylinder-surface *f*, and from the edges of a gap *B*, left upon the cylinder-surface extend the side walls of box *K*, as shown. A thin layer of felt or other yielding elastic substance is placed upon the cylinder-surface and is bent over the edges of the gap and secured to the side walls of the box *K*. This layer of elastic material is designed to serve as the support for the record-surface both in recording and reproducing.

"For recording I employ a thin strip of paper, parchment, metal, or any other suitable substance, which is secured at both ends to bars *c* and *d*, in the manner shown in Fig. 7, with reference to a copy of a record, and is then placed upon the elastic support *f'*, with the bars *cd* entering into but projecting at both ends beyond the box *K*, as illustrated in Figs. 1 and 4, with reference to an engraved copy of a record. Bolts *q*, passing through the projecting ends of bars *cd*, are employed to draw the record strip tightly about the drum, and the length of the strip is such that the ends of the same meet as nearly as practicable upon a straight line, *s*. The record-sheet is then prepared to receive the record by covering its surface with a thin layer of any substance which is easily removed by the action of the recording stylus. I may use lamp-black, which is deposited by placing a smoky flame under the record-strip and by slowly turning the drum until all parts of the strip are covered with the deposit. It is well known that a layer of lamp-black thus deposited, while it adheres well to the surface of a solid body, is nevertheless easily removed from the same. It requires only an exceedingly small force to draw a plainly-visible line upon such surface, owing to the fact that the spicules of carbon of which lamp-black is composed are only loosely superimposed upon each other, and are exceedingly light. All this has long since been recognized and utilized

BC-946-B BROADCAST RECEIVER

520 to 1500 Kc broadcast band. 6 tubes: 3-12SK7, 12SR7, 12A6, 12K8. For dynamotor operation. Easily converted to 110 volt or 32 volt use. Two IF stages, 3-gang tuning. Good. BRAND NEW in sealed carton, with all tubes . . . **$19.95**

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BC-456	Modulator	2.24	2.75	4.24
BC-457	Transmitter 4-5.3 Mc	7.95	11.95	12.95
BC-458	Transmitter 5.3-7 Mc	5.25	7.95	8.95
BC-459	Transmitter 7-9.1 Mc	7.95	9.95	11.95
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BC-451	Transmitter Control Box	....	1.25	1.49
BC-696	Transmitter 3-4 Mc	....	14.75	19.50

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Navy Type Comm. Transmitter 2.1-3 Mc BRAND NEW with Tubes $19.45

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Aluminum case for BC-221 or TS-164 Freq. Meters. With volt. reg. supply using VR105, 2 ballast tubes, relay, cable, etc. Inside front: 9¾ x 7½ x 7⅛". Inside rear: 2" deep. Shock-mounted.

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Ham Special! Famous BC-645 XMITTER-RECEIVER

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MN-26-C. 12-tube remote control Navigation Direction Finder and communications receiver. 150 to 1500 Kc in 3 bands. 28 V. DC input. Ideal for commercial navigation on boats and planes. Complete installation comprises:

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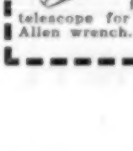
150 to 7 Mc. Complete with tubes, motor; original manuals. **BRAND NEW** . . . **$21.95**



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Model	Description	Excellent Used	BRAND NEW
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HS-33	Low Impedance	1.79	4.65
HS-30	Low Imp. (featherwt.) .	1.49	1.85
H-16/U	High Imp. (2 units) . .	2.75	7.95
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Model	Description	Excellent Used	BRAND NEW
T-17	Carbon Hand Mike	$5.45	$7.95
T-30	Carbon Throat Mike . . .	.33	.69
T-45	Navy Lip Mike		.99
RS-38	Navy Type	2.25	4.95
T-24	Carbon Mike		3.95

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Type	Input	Output	Excellent Used	BRAND NEW
DM-44A	12V 6.1A	275V .150A	....	$7.95
DM-40	14V 3.4A	172V .135A	1.95	3.95
DM-42A	14V 46A	515/1030 /2/ MA 215/250	5.95	12.95
DM-43A	28V 23A	515/1030 /2/ MA 215/250	6 22.50	....
DM-32A	28V 1.1A	250V .05A	2.95	5.95
DM-34D	12V 2.8A	220V .0mA	4.25	5.50
DM-35D	12.5V 18.7A.	625V .225A	6.95	10.95
DM-37	25.5V 9.2A	625V .225A	6.95	9.95
DM-25	28V	224V .07A	1.95	4.95
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DM-33A	28V 6A 28V 7A	675V .15A 540V .25A	1.95	3.95
PE-101C	12V 12.5A 28V 6.3A	400V .135A 8VAC 1.12A	....	7.95
PE-103	6V 12V	500V .100A 500V .150A	19.50	34.50
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in the production of phonautographic records, and I take advantage of these facts in my improved method of recording and reproducing sounds.

"The diaphragm *m* is mounted in a frame, *n*, with its plane at right angles to the axis of drum *G*. A post, *O*, is fixed to the center of the diaphragm, and a slot in said post receives one end of stylus *S*, which is pivoted in the post by a pin, *t*. The stylus extends over and beyond the frame, with its free end barely in contact with the record-surface, and is also pivotally supported in a slot in a post, *p*, secured to the frame by means of a pin, *u*, as shown in Figs. 1 and 2. It will now be seen that the stylus is, in effect, a lever having its fulcrum in the pin *u*, and that its free end can only move in lines practically parallel to the record-surface. If it is now desired to produce a record of sounds the drum is slowly and uniformly rotated by means of crank *I*, or by any other suitable means, and sounds are uttered or directed against the diaphragm. Under the impact of the sound-waves the diaphragm is set into vibrations, whereby the free end of the stylus is also caused to vibrate to the right and left of its normal position, removing at the same time an undulating line, *y*, of lamp-black from the record-surface, as indicated, greatly exaggerated, in Fig. 5. Since in this operation the stylus only penetrates a uniform layer of loosely-heaped carbon spicules and barely touches the record-surface, it is clear that the slight friction at the free end of the stylus will be uniform, whatever be the amplitude of vibration. Consequently the vibrations of the diaphragm will not be modified or changed by the reaction upon the same of a sensible and varying resistance, as is the case in all other mechanical sound-recorders.

"Having thus obtained an accurate phonautographic record, the same may be fixed by applying a thin solution of varnish of any kind which dries very rapidly and which does not obliterate or change the record.

"If in this process the deposit of lamp-black be made thick enough, the line drawn by the stylus would represent a groove of even depth, preserving all the characteristics of the sounds which produced it and which may be handled and touched with impunity. The latter is then removed from the drum and may be preserved any length of time without danger of its being disfigured. This record I then copy in solid resisting material, preferably metal, either by the purely mechanical process of engraving, or by chemical deposition, or by photo-engraving. I prefer the last-named process, which enables me to produce the most accurate copy of the original record in copper, nickel, or any other metal without in any way or manner affecting the original record. The copy thus obtained, which may be multiplied to any desired extent, is a grooved waveline upon a strip or sheet of copper or other metal, as shown in Figs. 1, 4,

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Berliner's reproducing apparatus, May 1888.

6, and 7, and for the reproduction of the recorded sounds it has the advantage over the ordinary records in tin-foil, wax, etc., that it is not sensibly attacked by the reproducing-stylus, and will stand an indefinite number of reproductions without the slightest variation in the accuracy and loudness of the reproduced sounds.

"The copied record is fixed at both ends of the bars *cd*, as shown in Fig. 7, and is placed upon the elastic support *f'* upon the drum in the same manner as has been described with reference to the original record-strip, and as is illustrated in Figs. 1 and 4. Care must be taken that the two ends of the undulatory groove *y* meet exactly, as will be readily understood. This condition of the appartus is shown in Fig. 1 with the engraven-record upon the drum and the free end of the stylus entering the undulatory groove. If now, the drum is rotated with uniform speed, the end of the stylus will be forced to follow the undulations of the groove *y*, and the diaphragm will be vibrated positively in both directions in strict accordance therewith and will therefore reproduce the exact sounds which originally produced the record. This peculiarity of positive vibratory movement in both directions of the diaphragm is a feature which also distinguishes my method and my apparatus from others heretofore used.

"In the phonograph and graphophone the end of the reproducing-stylus which bears upon the indented or engraved record has a vertical upward and downward movement. It is forced upwardly in a positive manner by riding over the elevated portion of the record, but its downward movement is effected solely by the elastic force of the diaphragm, which latter is always under tension. In my improved apparatus the stylus travels in a groove of even depth and is moved positively in both directions. It does not depend upon the elasticity of the diaphragm for its movement in one direction. This I consider to be an advantage, since by this method the whole movement of the diaphragm is positively controlled by the record, and is not affected or modified by the physical conditions of the diaphragm, which conditions necessarily vary from time to time and constitute some of the causes of imperfect reproduction of recorded sounds."

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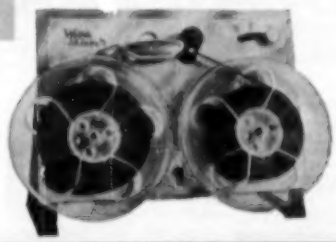

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tablished and later perfected through the years. From this crude beginning has emerged the high-fidelity disc of today.

Berliner's first commercial "Gramophone" (Fig. 2) was known as the "American Hand Machine," and was produced late in 1894 or in early 1895. Records do not show the exact date. The very earliest ads claimed that the machine was so simple that a child could operate it.

The following instructions appearing in the original user's guide will be of specific interest to the audio technician familiar with modern terminology, and the contrast will be found to be most revealing:

"The American Hand Gramophone reproducer is a talking machine which is both simple and effective, and will not easily get out of order, provided that the following directions are carefully kept in mind:

"1. Place the machine before you, as shown in the picture, resting the arm fully upon the table, and turn the handwheel with a *wrist* movement at the rate of about 150 times a minute. To acquire this regularity of motion, practice it a number of times with the lever and sound-box lifted off from the turntable.

"Hold the handle loosely, so that it slides readily through the fingers.

"2. The standard velocity of the center turn-table for 7-inch plates is about 70 revolutions a minute. A more rapid motion will raise the pitch of and sharpen the sound; a slower motion will deepen the same. *First get the speed and then place the reproducer and needle into the outer groove or the next one.*

"3. The needle points should be *firmly set*, and must not be removed until worn off—generally after about 12 or more reproductions for 7-inch discs, if the same plate is used many times in succession—because the edges gradually forming might scratch the plate or render the sound less pure.

"If then another record plate is taken it may occur that, its groove being of a different width than the last, the somewhat worn needle point will not fit at once, and the reproduction will be less pure than if a fresh needle was inserted.

"If a magnifying glass of about 4 *diameter* power and a small Kansas oilstone be handy, the worn needles can easily be reground to the rounded point of a darning needle. In fact, the broken-off ends of darning needles ("Thorpes" No. 14), which are of *the same thickness* as our standard needles, are excellent substitutes.

"Very thick points give a louder tone, but will gradually wear the plates; thin needle points will give a weak sound.

"4. The sound-box is so adjusted by a screw nut on the sound-post underneath the twisted spring that the latter presses moderately against the diaphragm. By lifting the free end of this spring upwards a little, this can always be ascertained. To move the

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adjustment nut, apply any pointed tool to its milled part.

"The rubber tubing around the center of springs will, like all rubber, lose its elasticity in the course of time, and produce a thin tone; it must then be replaced by a similar tubing of the same quality, *i.e.*, a firm gray rubber for the sound spring and a soft quality for the upper or adjusting spring.

"This adjusting spring enables you to have either a loud and full toned reproduction by having it *out of contact* with the rubber tubing of the twisted sound-spring, or, if a smaller but clearer tone is desirable, such as when listening to speech, songs or some band plates, with an ear-tube, to then screw it *firmly down*. Between these extremes the pressure may be varied and the sound modified. Conditions differ, and some records sound better to some people by ear-tubes and some by the horn.

"5. When the machine is out of use it is advised to raise the turn-table out of contact with the small rubber friction wheel, by means of the hand screw underneath. This will prevent the friction wheel from becoming indented by the continuous depression; but turn the hand screw well down when starting to use the machine, to prevent rattling.

"6. When light rolling sounds are heard from the machine, they may be due to various causes. Either the flywheel rests too loosely in its pivot points or the small rubber friction wheel has worn off and is uneven, or the center table may have received a knock and does not run true.

"7. In the case of light rattling or singing metallic sounds, they are always due to loose contacts or loose screws, or chips may have found access into the sound-box, or light articles may lie loose on the table nearby, or the adjusting lever may touch a metallic bearing.

"8. The two perforated plugs in the tube of the sound-box should be in correct position, one at each end of the tube.

"9. It is often of advantage—particularly with loud sounds—to press a left finger lightly upon the screw holding the needle-point.

Recording diaphragm and stylus of May, 1888.

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"10. Hangings and carpets deaden the sound from the horn; turning the latter close against a wall or door or wooden partition or against the corner of a room will heighten the effect and in particular will enable *the person turning the machine* to hear it well.

"11. Oil the revolving bearings occasionally, but be careful that no oil touches the rubber friction wheel or other rubber parts, because they would gradually soften. If the pulley cord is worn, replace it by a similar one drawn pretty firmly, but not too tight; *do not use silk-covered rubber cord* but always thick *cotton* covered, and you may rub the latter with beeswax or rosin.

"12. The center turn-table is adjustable up and downward by a screw underneath the baseboard. The table should *just compress the rubber friction wheel,* but should rest and *turn* on the adjusting screw underneath the baseboard.

"The fly-wheel must be nicely adjusted and the pivot screw set by the small screws on the side. It should have free motion enough without rattling.

"13. When sound is reproduced from original *zinc* etchings, "personal" plates, only perfect needle points must be used, and with delicate etchings they ought to be changed after every second reproduction, or reground.

"14. Our sound-records stand any climate, and no special care is required in handling them.

"15. The hand-wheel has two extra pulleys for the application of power, but special electric motor gramophones have also been designed. *See that the shaft of this wheel fits loose enough between the two leather washers.*

"16. Printed sound-records adapted for the purpose of studying sound-curves, and catalogues of plates will be published from time to time.

"17. As quickly as expedient, gramophone recording offices will be established, which will enable you to have your own voice and the voices of your friends and relatives, taken. Copies of such personal records can be furnished *ad libitum.*

"18. The sounds can be heard through the teeth. To get the best results procure a stick, preferably a bamboo, as thick as a pencil and about 10 inches long, tie a thick darning needle to one end, stop the ears with cotton wads, put the other end between the teeth and press the stick lightly into the revolving groove. If too loud or harsh interpose a piece of soft rubber tubing at the top, which press firmly between the teeth.

"A violin or similar instrument held against this top end will render the sound very loud.

"19. Persons hard of hearing should use large single ear-tubes.

"20. With each machine at least 50 needle points are given. Additional ones may be had at 20 cents per hundred.

"21. If your sound-box or apparatus should ever need readjusting and you are unable to accomplish it, we or our

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agents will do so free, on the payment of express charges.

"22. The underlying principles of sound reproduction with *stylus and diaphragm*, as later embodied in the gramophone, were elaborated before the invention of any other talking machine. For a full account of the invention and its relation to others see 'The Journal of the Franklin Institute' of June, 1888."

The "American Hand Machine" was manufactured by the *U.S. Gramophone Company* in Washington, D. C. The hand machine was followed by the "Battery Motor Gramophone" Type B (Fig. 3). This machine was powered with one cell of a storage battery or the Grove or Bunsen cell. It was equipped with a speed regulator (a dual ball governor) and was free of any gears. The turntable was driven directly by the revolving armature through a belt driving a rubber-tired friction wheel.

Another type "Gramophone" was developed (Fig. 4) known as Type C and called the "Incandescent Current Motor Gramophone." It consisted of a combination of a hand machine with a standard motor. It operated by means of a 110-volt direct current motor. When current was not available, the hand machine could be lifted from the cabinet box containing the motor and then run by hand. It was priced at $50.00 including 12 plates, records, that is. Most of the Berliner models used a 7-inch record which was a single-sided disc.

Berliner used a piece of clear glass during his demonstrations to show that when an iridium-pointed stylus was rubbed thereon a scraping sound would be barely perceptible. He was then in communication with a firm making ornamental glass tiles made by impressing upon red hot glass plates fancy designs in relief or intaglio by a strong pressure. Berliner felt that he could impress a matrix showing the sound record in raised lines upon a glass plate and that he could obtain a groove in glass giving a loud reproduction with a minimum disturbing sound due to friction.

Berliner also advanced the idea of mounting the sounder on a carriage and rails and having the record groove itself be the screw which was to guide the point of the stylus across the disc from periphery to center. This was improved upon by Werner Suess who was a mechanic in Berliner's little shop in Washington. It was Suess who first suggested that the sounder be mounted on a pivot at some distance from the disc and to then let the reproducing groove guide the sounder across the disc over an arc of flat amplitude.

An interesting postscript is a statement from a speech given by Berliner in Washington in which he states, "One of the peculiarities inherent with the gramophone is the possibility to enlarge the original sound by enlarging the printed vibratory characters of speech and then photo-engrave the same. In this manner it would be pos-

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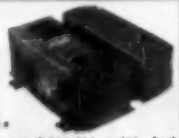

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simple gears driving a seven inch turntable. A conventional ball-type governor stabilized the speed. The hub of the turntable was threaded to permit a locking removable disc to be screwed in place to prevent slippage of the disc upon the turntable.

The earliest models employed a metal horn having a straight tapered bell, see Figs. 3 and 4. The curving bell followed later and is shown on the trademark. The horn was coupled to the reproducer (then called sound box) by means of a leather elbow. The tone arm was of oak and was pivoted to a side mounted arm serving as a bracket. The horn rested on a simple wire cradle.

These machines were made by the *National Gram-o-phone Co.* of New York. They were later called the "Zon-o-phones."

Subsequent chapters will be devoted to the contributions made by Tainter, Bell, Johnson, and others.

(To be continued)

INTERNATIONAL CONTACTS

THE Federal Communications Commission is again recapitulating the regulations governing international contacts by amateurs to eliminate possibility of infractions.

Communications between ham stations of different countries are forbidden where the administration of one of the countries objects. Cambodia, Indonesia, Iran, Korea, and Viet Nam are on the banned list. As yet there is no amateur service in Jordan and Roumania. Laos and Thailand have lifted their bans on such contacts.

Transmissions, where permitted, must be made in plain language and be limited to messages of technical nature relating to tests and to remarks of a personal character which are too unimportant to be handled by commercial services. Third party communications are expressly forbidden except between the United States and Canada, Chile, Cuba, Ecuador, Liberia, and Peru. Stations with prefixes KA2 through KA9 are excluded from all third-party transmissions. —30—

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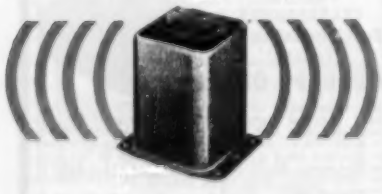

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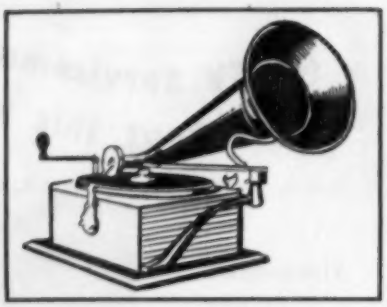

Fig. 5. The "Improved Gramophone" of the mid-nineties developed by Emile Berliner.

sible to get the reproduction at a much greater volume than the original sound. It would be interesting if some day speakers in a large hall would prefer to do their talking by machine, or to send speeches to a convention which they were unable to attend in person."

The Improved Gramophone

Berliner developed a spring-driven "Gramophone" in the mid-nineties which he called "Improved Gramophone." This is shown in Fig. 5. This machine will immediately become familiar to the layman as being almost identical to the trademark model of the *Victor Talking Machine Co.* and later adopted as the trademark of *RCA Victor*. The fabulous story of the *Victor Talking Machine Co.* and Eldridge Johnson will be told in a later chapter of this series. Berliner applied for a trademark on May 26, 1900. In his Statement, he claimed in part, "My trademark consists of the picture of a dog in the act of listening to a sound-reproducing-machine. This picture has been generally arranged as represented in the accompanying facsimile, which shows a sound-reproducing-machine and a dog apparently listening to the sounds issuing from the horn of said machine. Underneath said picture appear the words 'His Master's Voice'; but this is unimportant and may be omitted, since the essential feature of my trademark is the picture of the dog listening to the sound-reproducing-machine." Berliner's trademark, Fig. 6, clearly shows the "Improved Gramophone" with its outside spring and vertically mounted crank. This machine employed a set of

Fig. 6. Berliner's trademark application.

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RADIO-TV Service Industry News

AS REPORTED BY THE TELEVISION TECHNICIANS LECTURE BUREAU

FOR many years, operators of independent service businesses bitterly opposed any form of political licensing for any phase of electronic service. They felt that the incursion of political direction or control in the service field would only add to their deadweight overhead burden without eliminating any of the evils that kept independent service in bad repute with the set-owning public.

In opposing licensing, the majority feeling was that a great deal of the trouble was due to the newness of the activity and the necessity for building a service business through trial and error. The consensus was that when the successful pattern for the operation of a service business was established, it would not be too great a job to eliminate the gyps and the incompetents from the business.

In the course of time, the Better Business Bureau files of set-owner complaints posed serious handling problems to the BBB. In many areas, set owners complained directly to the district attorney's offices, especially customers whose sets were held for ransom by unscrupulous service companies. In those major centers where effective service associations were operating, the associations cooperated with their local BBB in checking complaints, but technical and legal complications made prosecution impossible. Everyone in the business knew who the gyps were but no one could do anything to stop them except to advise inquiring customers about their records.

Finally, in several areas, the service associations offered to gather evidence for their district attorneys to provide adequate, legally acceptable proof of fraud. This is expensive, time-consuming work. Busy service executives had to give freely of their time, without compensation, to accumulate evidence. Then they had to appear in court to verify the evidence. Convictions were obtained; the gyps were fined. However, it failed to eliminate the evil since many of the firms reopened in new locations under other names or moved to other localities to continue their depredations.

The futility of trying to eliminate the gyp operators through available legal channels became apparent. The costly and time-consuming work of gathering evidence and in meetings with the various agencies involved merely served to stop a few shady businesses temporarily while others were springing up, and there are no laws or legal business requirements to prevent a gyp from starting business again under a different name and in a new location.

The end result of all of this work has been that service business associations have been taking a new look at what can be accomplished through formal licensing of service businesses and, possibly, technicians.

State-wide electronic service business licensing bills are under consideration by many State Legislatures. Faster action, however, is being accomplished through City ordinances. One of the first of these city ordinances went into effect last August, in St. Paul, Minnesota. Since this subject is of interest to so many service operators, the entire text is given below:

"An ordinance to license and regulate persons, partnerships, firms, or corporations engaged in the business of repairing and servicing television sets, radios, or other electronic devices in the City of Saint Paul and providing a penalty for the violation thereof. This is an emergency ordinance rendered necessary for the preservation of the public peace, health, and safety.

"The council of the City of Saint Paul does ordain:

"Section 1. No person, firm, or corporation shall engage in the business of repairing and servicing television sets, radios, or other electronic devices using transistors and vacuum tubes within the limits of the City of Saint Paul without first having obtained a license in accordance with the terms and provisions of this ordinance.

"Section 2. Each applicant for license required herein must be of good moral character.

"Section 3. The amount to be paid for a license in accordance with the provision of Section 1 hereof shall be the sum of Thirty Dollars ($30.00) per year for each shop engaged in the repairing and servicing of television sets, radios, or other electronic devices using transistors and vacuum tubes in the City of Saint Paul, and shall be known as a master license, and Three

Dollars ($3.00) for each technician or serviceman employed by a shop having a Thirty Dollar license and which must bear the number of the master license. A licensee under this ordinance need not have a license under ordinance No. 8935, adopted July 22, 1947, in order to carry on the business described in Section 1 of this ordinance.

"Section 4. The business address of an applicant for a master license must be in accordance with the zoning code of the City of Saint Paul.

"Section 5. All shop work must be done at the business address of the holder of a master license.

"Section 6. Each applicant to qualify for a master's license must:

"(1) Have at least a tube checker, multimeter, oscilloscope, and a signal generator located at this business address.

"(2) File with the City of Saint Paul memorandums of insurance policies covering fire, theft, and damage to customer's property as well as public liability insurance while on the customer's premises.

"Section 7. A holder of a master's license shall be responsible for the qualifications in the field of electronics of each technician and serviceman employed by him.

"Section 8. The expiration date of a license required hereby shall be one year from the date of issuance of each license.

"Section 9. Any firm, person, or corporation violating any of the provisions of this ordinance shall be guilty of a Misdemeanor, and upon conviction thereof shall be punished by a fine not exceeding $100.00 or by imprisonment for a period not exceeding 90 days.

"Section 10. This ordinance is hereby declared to be an emergency ordinance rendered necessary for the preservation of the public peace, health, and safety.

"Section 11. This ordinance shall take effect and be in force from and after its passage, approval, and publication."

A State law, endorsed and actively supported by the Texas Electronics Association, recently went into effect in Texas. While this law does not touch upon the service industry as such, it is felt that it will help service businesses materially by eliminating backdoor selling of television and radio sets and sound equipment by distributors.

The law was written to tighten the method of collecting a 2.2 per-cent tax on radio and TV sales in Texas. Its major features are that it requires every radio and TV retailer to secure a permit from the State Comptroller to do business and to post a bond to guarantee payment of the tax. Distributors are prohibited from selling sets to retailers unless the latter holds a State permit.

While one of the aims of the new law is to curtail sales to the public by wholesalers and distributors, it will not prevent such sales. A distributor may qualify as a retailer by posting

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Hallicrafters SX-96 Only $13.62 per mo. Pay Just $25.00 Down Cash Price: $249.95

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Replying to Mr. Barlowe's letter, H. H. Rainer, Manager of the Distributor Sales Department for Electronic Products for *Sylvania*, said:

"Mr. Mitchell has asked me to reply to your letter of September 6th, which, as you know, we did not receive until September 13th.

"We appreciate very much your bringing this problem to our attention. It is a very complex matter and one to which we have given considerable attention and discussion.

"It is our policy, of course, to sell *Sylvania* tubes only to distributors for further distribution in the renewal market, and we do not believe we have violated the Robinson-Patman Act in any respect in these sales. Furthermore, I am sure you can appreciate that the anti-trust laws do not permit us to fix the price at which our distributors resell *Sylvania* tubes, or to restrict our distributors as to the customers to whom they may sell.

"On the other hand, we are very much concerned with the effect of the practice which you describe on the service industry, for whose benefit we have carried out promotional programs for many years. Indeed, these programs and policies have been for our mutual benefit. We appreciate your pointing out our past record in this regard, and we are proud of this accomplishment.

"Due to the importance of this subject, I have asked our New York District Sales Manager, Mr. Justin J. McCarthy, to discuss the entire problem with you. You may expect a visit from Mr. McCarthy in the very near future."

Other Developments

The discussions among service operators of ways and means to whip their most pressing problems have led to a review of the advantages to be gained by encouraging the unionization of independent electronic service shops. Service promoters with slick schemes to entice set owners to call their numbers for service and who "farm out" the work at a low price to basement technicians have added another sore spot for set-owner dissatisfaction with independent service in many areas. It is felt by some service executives that unionization of shops and technicians would give the legitimate shops a strong tool to prevent this type of service chicanery.

Efforts to create a healthier business atmosphere for independent electronic service are not confined to comparatively slow-moving programs such as licensing, etc. A frontal attack on service gyps is being made in many

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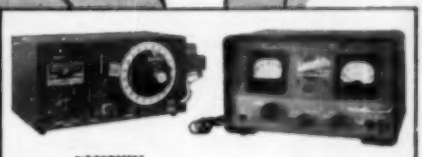

LAMPKIN 105-B MICROMETER FREQUENCY METER

Measures numerous crystal-controlled transmitters, 0.1 to 500 mc. Gives error from assigned frequencies. VHF CW signal generator. Weight 13 lbs., width 13". $220.00

LAMPKIN 205-A FM MODULATION METER

Reads peak FM voice deviation ±25 kc., tunes 25-500 mc. in one band. Relative field-strength meter. Speaker. Jack for oscilloscope. Weight 13 lbs., width 12". $240.00

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AUTO REAR SPEAKER KIT—Includes handsome 5"x7" CHROME Grille, PM speaker & 3 way panel switch with indicator plate $3.98
SHIELDED CABLE for auto spkr. connection, per ft. 2¢
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LINEN BAKELITE STRIPS—1½"x1½"x⅛" . . . . . 09¢
sq. 18¢; 6/$1.00
FLEXIBLE REMOTE CONTROL CABLE (1.150)—5 ft. . . . . 09¢
1" SOLID BRASS PULLEYS—¼" I.D., ⅛" thick . . . . . ea. 18¢; 6/$1.00
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0-10 mil **$3.95**

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MODEL 1011—A fine meter suitable for compact grid dipper, field strength, many other applications. 0-500 Microamps .....ea. **$4.95**

ALLIED 110 VAC 60 cy RELAY. 4 Pole D.T. Contacts pure silver. 10 amp. $1.75

12 V. DYNAMOTOR CONVERTOR. A rugged relay completely enclosed. Will start any 12V Dynamotor. Heavy contacts. $1.75 ea.

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(Ideal for Model Controls, Etc.)

Contains a sigma midget 8,000 ohm, relay (trips at less than 2 MA), high impedance choke, bimetal strip, neon pilot and many useful parts. The sensitive relay alone is worth much more than the total low price of **$1.25** Each 10 for **$9.90**

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5000 ohm coil operates on 1 ma. adjustable contacts, adjustable armature tension. SPDT-Bakelite base. Ideal for model work. Can also be used on AC. Draws 4 mil AC @ 110 V. Ideal for burglar alarm ..... **$1.75** ea.
5 for **$7.50**

OIL CONDENSER SPECIALS
BRAND NEW

2 MFD	600 VDC	$.50	10 MFD	1400 VDC	$2.50
4 MFD	600 VDC	.75	2 MFD	2000 VDC	1.50
8 MFD	600 VDC	.95	4 MFD	2000 VDC	3.50
10 MFD	600 VDC	1.19	1 MFD	3000 VDC	1.85
2 MFD	1000 VDC	.85	1 MFD	3500 VDC	2.25
4 MFD	1000 VDC	1.25	3 MFD	4000 VDC	5.95
8 MFD	1000 VDC	1.50	5 MFD	330 AC (1000 DC)	.95
6 MFD	1500 VDC	1.95	6 MFD	660 AC (2000 DC)	1.95

NEW PANEL METERS
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0-100 Microamp	$5.95	25-0-25 Volts DC	3.95
100-0-100 Microamp	4.95	0-600 Volts DC	4.50
0-40 Volts DC	2.45	0-1½ Milliamps	2.95
0-1 Mil	3.95	0-10 Milliamps	3.95
0-1½ Mil	2.95	0-15 Milliamps	3.95
0-25 Mil	2.95	15-0-15 Milliamps	2.95
0-300 Mil	2.95	0-50 Milliamps	2.95
10-0-10 Amps DC	2.95	0-300 Milliamps	2.95
0-15 Volts AC	2.95	0-500 Milliamps	2.95
0-300 Volt AC	3.95	0-15 Amps DC	2.95
—10 to +600	3.95	0-15 Volts AC	3.95
3" METERS		0-50 Volts AC	3.95
0-6 Volts DC	$3.95	0-150 Volts AC	4.50
0-10 Volts DC	3.95		

SHIELDED CHOKES

12 Henry 150 Ma.	$1.65
8 Henry 200 Ma.	1.95
Thordarson 15 Henry 200 Ma.	2.25
6 Henry 300 Ma.	2.95
6 Henry 1200 Ma (12KV ins.)	22.50

WESTINGHOUSE RF meter 2½" bakelite case. Int. therm. Scale linear from 1-9 amps, 0-9 amps. $2.99 ea. 2 for $5.50

WESTON MODEL 506. 2½" ba. bakelite case. An outstanding value. 0-40 Volts $2.95
2 for $5.50

READ 'N' SAVE BARGAINS

500 MMF CERAMIC CONDENSERS.....10 for 9.00
6 Volt RELAY DPDT.....75
150 MMF Var. Cond. shielded (mod. 58).....49
SANGAMO FIL .001 5000 VOLTS WORKING—TRANSMITTING MICA CONDENSER.....75
25 WIRE WOUND RESISTORS in KIT.....1.95
.01 MMF 1000 VDC MICAS.....5 for .95
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100,000 OHM, 100 WATT RESIST.....49
GLOBAR 9 OHM 100 WATT (non-inductive).....6 for 1.49
OHMITE WIRE WOUND (non-inductive) 250 OHM 100 WATT 99c ea.....5 for 3.50
1 MFD Oil Condenser 400 VDC. 25¢ ea.....10 for 2.00

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bond and securing a permit, the same as required of a dealer.

The original bill, as introduced in the Legislature, called for a 3 per-cent gross receipts tax on radios and TV sets to be collected and sent to the State by the distributors. Distributors objected and, as the bill was finally worked out in committee with representatives of the Texas Electronics Association, the tax was retained as an excise tax, with the retailer sending in the taxes.

Jobber Retail Sales

A new approach to eliminate or curtail the indiscriminate sale of replacement parts and tubes to the public at dealer net prices was recently launched by the Radio Television Guild of Long Island. For more than a year they have been shopping Long Island parts distributors to determine which distributors are selling replacement products to anyone walking up to their counters without any effort to get identification of a person's right to purchase such products at dealer net prices. During this period, many distributors tightened their sales policies to eliminate sales to unauthorized persons.

Recently, Murray Barlowe, president of the Guild, sent the following letter to Don G. Mitchell, president of *Sylvania Electric Products:*

"The electronic service industry is well aware of *Sylvania's* past record of cooperation with the independent service industry. The Radio Television Guild of Long Island, representing over three hundred service dealers and technicians, are confident that your company would not want to be instrumental in putting the independent service dealer in an unfair competitive position. We feel sure that when the facts are made known to the proper people, immediate corrective action will be forthcoming.

"These are the facts!

"Long Island is presently without a 'wholesale' *Sylvania* distributor. The Distributor Shopping Program conducted by the Guild during the past year substantiates this fact.

"The franchised dealers appointed by your company to serve the service dealers in this area are in open competition with them for the same customer, the retail consumer! The independent service dealer is placed in the unfair position of having to compete with his supplier, without the benefit of the franchise which provides an additional discount.

"Under the provisions of the Robinson-Patman Anti-Discrimination Act, it is unlawful for a 'Manufacturer engaged in interstate commerce to discriminate in price between different purchasers of commodities of like grade and quality.'

"To correct these unfair conditions as they exist today, we, the members of the Radio Television Guild of Long Island, formally request the opportunity to buy our *Sylvania* products from you (directly or otherwise) at the

STATEMENT REQUIRED BY THE ACT OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946 (TITLE 39, UNITED STATES CODE, SECTION 233) SHOWING THE OWNERSHIP, MANAGEMENT, AND CIRCULATION OF Radio & Television News, published monthly at Chicago, Ill., for October 1, 1955.

1. The names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Ziff-Davis Publishing Company, 64 E. Lake St., Chicago 1, Ill.; Editor, Oliver Read, 366 Madison Ave., N. Y. 17, N. Y.; Managing editor, Wm. A. Stocklin, 366 Madison Ave., N. Y. 17, N. Y.; Business manager, G. E. Carney, 366 Madison Ave., N. Y. 17, N. Y.

2. The owner is: Ziff-Davis Publishing Company, 64 East Lake St., Chicago 1, Illinois; Estate of William B. Ziff, 366 Madison Ave., N. Y. 17, N. Y.; A. M. Ziff, 366 Madison Ave., N. Y. 17, N. Y.; B. G. Davis, 366 Madison Ave., N. Y. 17, N. Y.; S. Davis, 366 Madison Ave., N. Y. 17, N. Y.

3. The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: Modern Woodmen of America, Rock Island, Illinois

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was: (This information is required from daily, weekly, semiweekly, and triweekly newspapers only.)

G. E. CARNEY, Business Manager.

Sworn to and subscribed before me this 27th day of September, 1955.
(SEAL) VICTOR C. STABILE, Notary Public.
(My commission expires March 30, 1957)

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1-222 SIGNAL GENERATOR MICRO-VOLTER

Freq. range: 8-15 MC. and 150-230 MC. Complete with all tubes and 5 MC. calibration crystal. Self-contained 110V, 60 cyc. power supply. Good condition **$19.95**

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sections. Typical of these programs is the campaign now being waged by the Denver area Better Business Bureau through its newly formed division, the Electronic Technicians Association. The Denver campaign started with a full page ad in the Denver newspapers in which the member shops in ETA were all listed. This was followed by daily ads run by individual members ridiculing the practices of the gyps in promoting the sale of their services.

The most impressive and striking part of the full-page ad that launched this campaign was a column printed in bold face type and headed "Tricks of the Gyps." This write-up did not pull any punches in detailing the tricks of the gyps in enticing set owners to call them for service.

"By knowing the tricks used by the gyps, you can protect yourself from loss. By knowing what to expect from the honest service man, you can assure yourself of maximum satisfaction.

"For instance, the offering of a TV service call for $1.50, $2, or $3 more often boomerangs into a charge of $20, $50, and sometimes over $100, if you respond to it. That low priced bait is only for suckers who simply can't resist getting 'hooked' by ridiculous offers that sound too good to be true, and are.

"Gypsters also make a practice of running up your bill by taking perfectly good tubes out of your set and charging you for replacements, sometimes with tubes of inferior quality.

"A guarantee made by a gyp is apt to be worthless. Trying to get him to make good on faulty work or parts is a fruitless waste of time and effort.

" 'Phony' estimates are also the earmark of a gyp, who will often claim that your set needs extensive repairs when, in fact, it may only need parts costing a few dollars.

"Some questionable firms operate under several different names, or only a telephone number without a name. This masquerade makes it difficult for irate customers to locate the firm or make a personal visit to the place of business.

"Reputable firms do not use tactics designed to take advantage of your ignorance; nor to mislead or deceive you with 'bait' advertising, or 'phony' estimates, or worthless guarantees, or other tricks mentioned here.

"Your best assurance of honest service is to deal with a reliable firm that is forthright in its customer relations and which works to deserve public confidence, for to business in Denver—*public confidence counts most!*"

The ad offers to furnish the readers with a copy of a new booklet entitled "TV Without Tears." This booklet tells the set owner what to avoid as well as how to choose a reputable service company.

"TV Without Tears" is published by the *Bureau of National Affairs, Inc.*, 1231 24th Street, N. W., Washington 7, D. C. They are priced at eight cents per copy. 100 copies is the minimum order accepted. —30—

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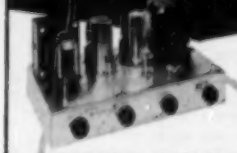

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Royal "Monarch" 3-speed record changer. Model RPS with turn-over cartridge. Made in England. Plays all 7, 10 and 12 inch records intermixed—absolutely jam proof.

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SPLINED TUNING KNOB FOR 274N RECEIVERS

An exclusive O-R item manufactured for us. Fits BC-453, BC-454 and other 274N receivers. This is a really hard-to-obtain item. Only . . 89c ea.

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21" TV CONVERSION KIT

Convert ANY MAKE TV RECEIVER including #630 to operate 21" or ANY 70° PICTURE TUBE. COMPLETE SET OF ESSENTIAL PARTS includes matched set of Todd 70° COSINE DEFLECTION YOKE and TODD HV FLYBACK TRANSFORMER.

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Your price... $13.97 Incl. CONVERSION MANUAL with Step-by-Step Instructions & Diagrams.

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AUTOMATIC RECORD CHANGER

3-SPEED INTERMIX ALL SIZE RECORDS

FLIP-OVER-CARTRIDGE AUTOMATIC SHUT-OFF $24.19

Modernize a #630 or any TV Set with a
STANDARD CASCODE TUNER
For better all around performance
Complete with tubes and NEW CASCODE MANUAL with step-by-step instructions and all extra parts needed. $15.97

PM SPEAKERS (ALNICO #5)
Brand New Factory Guaranteed Stock
1 oz. mag. on 3" to 6"
heavier mag. on 8" and 12"

3"	$ .98	6"	$1.58
4"	1.17	8"	2.64
5"	1.29	12"	4.67

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FACTORY DISTRIBUTOR FOR
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Available Now From Stock
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SPRAGUE

WORLD'S LARGEST CAPACITOR MANUFACTURER

Choosing a Preamp

(*Continued from page 45*)

the output is specified as 1.4 volts. Then the power amplifier he is using may fully load, that is, give its full power output, with an input of, say, .25 volt. If these two units are merely connected together, there will be plenty of gain but we shall not be making the best use of the signal-to-noise ratio of the preamplifier because full output from the power amplifier will be reached when the preamplifier is operated at a fraction of its potential.

To get the best discrimination against noise from the preamplifier a matching arrangement should be employed between the preamplifier and power amplifier so the full power output from the power amplifier is obtained when the preamplifier gives its rated 1.4 volts output. In this particular example the resistance network shown in Fig. 5 should be used.

Most modern preamplifiers and power amplifiers provide considerable overlap in this regard. For individual cases the rated output of the preamp, in conjunction with the rated input for the power amplifier, should be consulted, and an appropriate network made up so as to get the best operating conditions under all circumstances.

Some preamplifier manufacturers do not specify the output level. This is largely because preamplifiers, unlike power amplifiers, do not run into distortion suddenly. Therefore it is a little difficult to specify an exact output as a "maximum output." For example a preamplifier may give .1% distortion at 1.4 volts and only rise to .2% distortion at, say, 3 volts. This being the case, the exact attenuation placed between the preamp and power amplifier is not very critical, provided you do not reduce the gain so much that you have to push the preamplifier into distortion to get enough input into the power amplifier.

Usually there will be so much margin on the background noise level that a little attenuation between the preamplifier and power amplifier will render it inaudible—if it was audible under the condition of direct connection.

Not all preamplifiers incorporate all the features mentioned in the foregoing discussion. A preamplifier with all of these provisions would have a lot of knobs to twiddle and the average person would find it somewhat confusing to operate. It would be difficult to know which knob to turn to achieve a given effect. But the modern range of preamplifiers provides a good selection of these controls to give reasonable versatility with simplicity of operation. Each manufacturer has chosen his own way of solving the problem, in what he believes to be the manner that will best suit the user. The foregoing discussion has aimed at explaining all these methods, so you can decide which manufacturer has provided the solution that will suit your particular taste in music. —30—

"Wireless" for Americans

By LAWRENCE A. SHARPE

IT IS a well-known fact that we do not speak exactly the same language as our trans-Atlantic cousins in Great Britain. In literary works this difference is sufficiently pronounced for continental Europeans to specify on the title page whether a novel has been translated from English or "from the American."

In technical books the difference is not so pronounced due to parallel development and the international exchange of information. Still the American reader of such popular British electronics magazines as "Practical Wireless," "Practical Television," or "Wireless World" is constantly running into terms that are "quaint" to our way of thinking.

Fortunately, the American with a little good-will is able to decipher nearly all the usual words from the context. They may be terms known but not commonly used over here or words that are completely non-existent in American "English."

"Flex" is flexible lamp cord. The derivation is quite obvious but the word looks singularly unfamiliar at first glance. If a "H.T." battery (for high tension) is a "B" battery, then clearly an "L.T." battery is an "A" battery. A "valveholder" must be a tube socket since "valve" is the normal word for tube even though our word is used for TV picture tubes in England. "Demobbed valves" advertised in the magazines are, of course, surplus tubes.

When the lead touches the chassis of an English "wireless" set, it becomes "earthed" rather than "grounded," but these are, after all synonymous words. Such expressions as "shrouded drop through," however, are the ones that really stop the average American reader. It turns out to be a shielded "mains transformer" with the terminal end "dropping through" to the underside of the chassis, the opposite of the "shrouded upright." A highly misleading term is "radiogram" with the meaning of "radiophonograph combination," which in England may be bought on "hire-purchase terms" (installment plan) if desired!

After familiarizing himself with the examples given and a few other words, the American reader will feel pretty much at home in British radio literature. Diagrams are, of course, an international language. Here one may notice as a novelty the use of "pF" instead of "$\mu\mu$fd.", although the decimal forms with "mF" are also used. With a "valve manual" at hand to identify the exotic British tube designations and figure out American equivalents, one can have a great deal of fun learning how things are done on the "other side of the Big Pond." —30—

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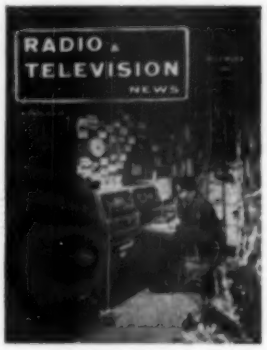

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1B3GT	.62	6BC5	.48	6SQ7	.40	12SN7GT	.56
1H5GT	.51	6BC7	.75	6T8	.71	12SQ7	.38
1L4	.51	6BE6	.46	6U8	.76	14A7	.43
1L6	.51	6BF5	.48	6V3	.80	14B6	.36
1LC6	.49	6BF6	.48	6V6GT	.48	14Q7	.52
1N5GT	.51	6BG6G	1.18	6W4GT	.43	19BG6G	1.98
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1S5	.43	6BJ6	.51	6X4	.37	25L6GT	.41
1T4	.51	6BK5	.75	6X5GT	.38	25BQ6GT	.82
1U4	.51	6BK7	.78	6X8	.80	25W4GT	.43
1U5	.43	6BL7GT	.78	6Y6G	.61	25Z5	.55
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3Q5GT	.61	6BQ7	.85	7F7	.59	35B5	.48
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3V4	.48	6C4	.41	7N7	.52	35L6GT	.41
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5V4	.49	6CD6G	1.63	12AT7	.71	35Y4	.42
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5Y4G	.37	6D6	.59	12AV6	.42	35Z5GT	.33
6A8	.40	6E5	.60	12AV7	.73	37	.59
6AB4	.43	6F5	.44	12AX4GT	.60	43	.55
6AC7	.65	6F6	.42	12AX7	.61	45	.55
6AG5	.52	6H6	.50	12AZ7	.61	50A5	.49
6AH4GT	.65	6J5	.49	12B4	.72	50B5	.48
6AF4	1.02	6J6	.61	12BA6	.46	50L6GT	.50
6AK5	.96	6K8	.60	12BA7	.58	50X6	.53
6AL5	.43	6K6GT	.39	12BE6	.46	75	.44
6AQ5	.48	6K7	.40	12BH7	.61	77	.55
6AR5	.48	6L6	.78	12BY7	.65	80	.40
6AS5	.52	6Q7	.40	12H6	.50	84	.46
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6AV6	.37	6SA7	.45	12Q7	.48	117N7GT	1.20
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6AL5	.43	.39	12SA7	.45	.41
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1LG5	.66	6BC7	.62	12A4	.60
1LH4	.60	6BE6	.51	12AF8	.37
1LN5	.66	6BG6G	1.25	12AQ5	.52
1R5	.63	6BH6	.63	12AT6	.41
1S4	.61	6BJ6	.49	12AT7	.78
1S5	.50	6BK7	.90	12AU6	.46
1U5	.60	6BK7	.90	12AU7	.66
1X2A	.98	6BL7GT	.93	12AV6	.39
2AF4	.68	6BN6	.74	12AV7	.78
2A3	.98	6BQ6GT	.98	12AX4	.67
2AL5	.42	6BQ7	.90	12AX7	.63
2AV6	.48	6BZ7	.90	12BA6	.50
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6AM8	.79	6Q7	.49	12SK7GT	.67
6AN8	.79	6S4	.49	12SN7GT	.69
6AQ5	.52	6SA7GT	.65	12SN7GT	.69
6AT6	.41	6SH7GT	.49	12SQ7GT	.64
6L6	.84	6SL7GT	.61	12SR7GT	.64
6V6	.71	6SK7GT	.63	12X4	.38
6U6G	.50	6SL7GT	.61	14A7	.63
6U8	.78	6SN7GT	.69	14B6	.63
6V6	.71	6SQ7GT	.49	14B7	.78
6V6	.80	6T4	.99	19AU4	.78
6X8	.78	6T8	.78	19BG6	1.25
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6AN8	.79	7A8	.69	35A5GT	.67
6AQ5	.52	7AG7	.69	35B5	.82
6AQ6	.46	7B7	.49	50A5	.82
6AQ7	.70	7B8	.78	50B5	.82
6AR8	.79	7C5	.59	50C5	.81
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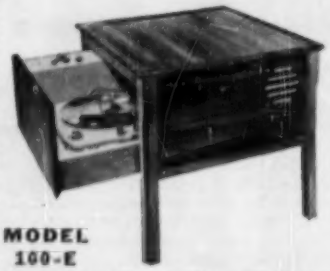

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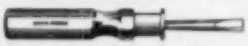

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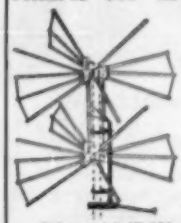

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An Extended Range Signal Generator .....102 Dec.
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ERRATA

Figs. 2, 5, and 6 (page 73) accompanying the article "Dynamic Crystal Diode Tester" in the September issue show the polarity of the crystal diode under test reversed.

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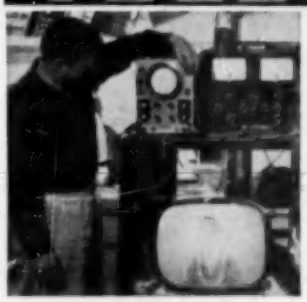

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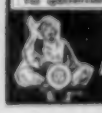

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TEST Equipment Repaired and Calibrated by Factory staff. All makes. Superior, Simpson, Triplett, etc. Free estimate. Our twentieth year. Douglas Instrument Laboratory, 176 Norfolk Avenue, Boston 19, Mass.

HIGH Fidelity Speakers Repaired. Amprite Speaker Service, 70 Vesey St., New York 7, N. Y. Ba. 7-2580.

TELEVISION Tuner Repairs. Dan's Television Laboratory, 2 West 183rd St., N. Y. 53, N. Y.

HELP WANTED

TELEVISION Jobs—Names and addresses of companies to contact. $1.00. Fitzgerald, (Chicago Division), Dept. A-14, 815 Countryside Drive, Wheaton, Illinois.

INSTRUCTOR well versed in radio and television service, degree preferred, to teach in trade division of small mid-western college. Send complete resume of education and experience to Dean, Trade and Industrial Division, Ferris Institute, Big Rapids, Michigan.

HIGH Fidelity Salesmen—Allied Radio has openings in its expanding Chicago area hi-fi studios for men who can demonstrate and sell high fidelity components. Good starting salary, pleasant working conditions in air-conditioned salesrooms, many employee benefits. Phone or write Mr. Unger, Allied Radio, 100 N. Western Ave., Chicago 80, Ill. Phone: HAymarket 1-6800.

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TV Service Business Established 5 Years. Health Forces Sale. Live-In House $2,500.00 + Inventory. P. O. Box 4233, Pasadena, Calif.

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USED Correspondence Courses and Books sold and rented. Money back guarantee. Catalog free. (Courses bought.) Lee Mountain, Pisgah, Ala.

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MANUFACTURERS! Successful manufacturing—selling instructions, guidance. Free Booklet: All-tools, 268T, New York 5.

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CRYSTAL Photocells, extremely sensitive type CL-1. $2.50 postpaid. Horton, Dept. A, 267 W. Eleventh Street, New York City, 14.

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for THE LATEST HI-FI EQUIPMENT

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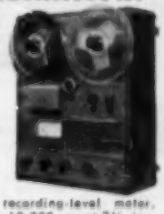

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PORTABLE TAPE RECORDER

Separate erase, record, and playback heads. Separate record and playback amplifiers. Direct-reading recording-level meter. Response ±2 db from 40 to 10,000 cps at 7½ ips.

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PORTABLE AMPLIFIER-SPEAKER SYSTEM

10-watt push-pull output. Less than 1% total harmonic distortion. Response ±0.25 db from 20 to 20,000 cps. Self powered. Volume level, equalization, and power controls. External speaker jack. $149.50

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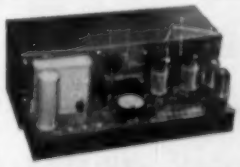

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40 WATT POWER AMPLIFIER

Built-in metered operational adjustment. Output transformer with low leakage reactance and high flux-handling capability. New type 6CA7 output tubes are more efficient and distortion-free. Variable damping from separate 4, 8, and 16 ohm outputs. Oil input-filter capacitor, long-life telephone-quality electrolytic condensers, terminal-board construction. $189.00

New
STAN WHITE
Model 4330
THE 'Hi-Fi'

Multi-flare horn system with 4 separate drivers. Bass (30-150 cps), 14' equivalent coaxial length, 7 sq. ft. mouth area. Lower mid-frequencies (150-600 cps), two 8" speakers with phase-shift network for 3-dimensional effect. High mid-frequencies (600-3000 cps), 6' equivalent axial length. Treble (3000-18,000 cps), 4' equivalent length. Response flat from 20 to 18,000 cps. 60-watt power handling capacity.

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NEW HIGH CURRENT POWER SUPPLIES—ONE YEAR GTD.

Variable 0-28 VDC, Completely Built. Full Wave Selenium Rectifier, Transformer, Meter, Volt & Amp Meters, Switch, Terminals & Fuse. In Rugged Steel Cabinet, Std. 115V/60cy In. 110 or 220V† and 3 phase to order. Specify.

Stk No.	Cont. Rating	W/Meters
T28V5A	0-28WVDC at 5 amp	$ 89
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T28V24ACC†	24 Amp (1% Ripple)	$329
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We mfg. Power Rectifiers to your specs. From 1 Amp up. Prices almost 1000 Amps. Following List. Full Wave Bridge.

Cont. Curr.	58/14 Volts	36/38 Volts	84/42 Volts	130/100 Volts
1AMP	$1.00	$2.70	$4.30	$9.40
2AMP	2.00	3.40	6.15	11.40
3AMP	3.45	4.75	8.70	14.80
4AMP	4.25	5.45	12.05	18.45
6AMP	5.60	10.05	14.75	21.50
10AMP	7.90	14.35	22.40	47.55
12AMP	9.20	18.10	28.40	50.85
20AMP	15.00	24.60	42.80	80.25
24AMP	18.40	30.74	51.15	97.75
30AMP	22.70	36.50	64.95	126.35
40AMP	28.50	46.80	84.50	164.15
80AMP	53.00	82.50	111.95	300.10

SELENIUM IS WORTH $ $

RETURN YOUR OLD DUD RECTIFIER DEDUCT 50% FROM PRICE

HEAVY DUTY BATTERY "FAST" CHARGER RECTIFIER

13-0-13V (CT) 100 Amp Fan Cooled or 34 Amp Air Cooled. Red/Green Overload Relay. Model CR16 . . . $12. 16-0-16V (CT) Fan Cooled. For 12V/60A and 6V/100A Fast Charger. Model CR30 . . . $14.

Write for New "TABTRON" Rectifier & Power Supply Catalog PR156

New "TABTRAN" Rectifier Xfmrs

Sec Volts (DUAL†) 18-18-9-0-0-9-18-18V

Primary 115V 60 Cyc.	
5 Amp†	$8.45; 2/$15.75
12 Amp†	$16.50; 2/$32.00
24 Amp†	$25.50; 2/$70.00
50 Amp†	$49.50; 2/$95.00
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18 Volt 2 Amps . . . . $1.98; 2 for $3.50
†Windings in Series at ratings shown; Parallel at 2X Amps. Voltage Same.
*Dual Pri 115 & 220V 60 cy; Tapped 36 VCT

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CR6002/1AMP/6.1HY/1.4R	$4.00; 2/$8
CR6003/3AMP/.07HY/.6R	2/$5
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New Variable 0 to 6 & 12 Volt/12A DC Power Supply

Battery Eliminator, Charger, Model RS, Plater, Aircraft, Marine or any DC Req. Extra Hvy Duty Selenium Rectifier, 2 Meters V & A. Designed for cont. service & up to 50 Amp intermittent overload. Model V612V12AC . . . $29.95

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SUPERIOR—GR—STACO—UTC

0-132V . . . 2.5A	$7.45
0-115V 5A	11.50
Cased 0-135V 7.5A	20.70
Uncased 0-115V 7.5A	17.25
Cased 0-270V 3A	23.40
Uncased 0-270V 3A	18.40
Cased 0-135V 15A	41.40
Cased 0-270V 9A	41.40

230 to 115V Autoformers

For 220-240V/50-60 cy. In. To 110-120V or Step-up, W/ Cord, Plug & Receptacle:

TPA025/25W†	$7.50
TPA075/75W†	12.45
TPA100/100W†	14.00
TPA200/200W†	20.75
TPA300/300W†	27.25
TPA500/500W†	38.75
TPA750/750W†	54.75
Model TPA1000/1000W/1 KW†	$76.95
Model TPA2000/2000W/2 KW†	$124.50

$100 Order Take 10% Disc. *Less C.P.&A

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C6160M 8500MFD 15V	
1Pkg: 2/$1.50; 10/$5	
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Only $16.98

LINE VOLTAGE STABILIZER Stabilizes line voltage within plus or minus 3% on VOLTAGE & FREQ. shift. Insured full sine, strength, & sync of TV picture regardless of line voltage. Automatically operated . . . regulator turns on & off with set or equipment. Trouble free, quiet, needs no adjustment. Universal use from 100 to 500 Watts. Input 100-125V/ Output 115V ± 3% 50-60 cy.

SOLD WITH "TAB" MONEY BACK GTD. Order 5-in and take 10% Discount

TRANSFORMERS

All 115V 60 Cyc. Input TV, & CR purr. xfmr. up to 20" tubes. Hi Volts up to 20 Kv. w/quadrupler ckt.; All tubes, PL & FIL wndgs. 5000 VDC/5MA. 500 VDC/275 MA Full-Wave; 6.4V/10.5A, 6.4V/8A, 2.5V/3A Hytercell Core, Oil Fill. . . . $4.98
2500V/30MA, 6.3V/6A, 2.5V/1.75A, for RC-412 Range Reprint. $7.98
900V/350MA, 2.5V/5A, 6.3VCT/5A Dbler. TWO 2x2 FIL WNDGS. $1.98
778VCT/200MA, 5V/3A, 6.3VCT/5A
CHICOMAGNO . . . $4.25; 2 for $8; 10/$35
770V/2.5MA, 2.5V/3A, RMSLD FILTER
PARTS 4/acmpo. . . . . $3.00; 2 for $6.00

PRECISION RESISTORS

W.E.—IRC—WILKOR
1% Accuracy Gtd.

10 of One Value . . . . ea. 10c
100 of One Value $4.00
10 Asst'd Values $1.50
Write for Catalog Sheet

NEW MINIATURE METER 0-1 MILLIAMP

Precision Jeweled D'Arsonval Mvt. Better than 2% Accy. Readable Long 1½" scale, 20 divisions. Ruggedized. Well Damped. Bakelite Case, Front Sq. or Rear Round Face Mtg. Mounts 1⅛" hole, 4 screws 1¼" ctrs. not surplus. Data sheet for shunt current ranges.
"TAB" SPECIAL . . . . . $3.88 @ 2 for $7

NEW "LUGER" SOLDERING GUN

Heat balanced, 150 WATTS heat at your fingertips. For fine or heavy duty soldering. Non-corroding alloy long & short tips, preformed twin lights, rugged construction. 120 VAC/60 cycles Input.
Model DS-1—
Single 100 Watt $6.95
Model DS-2—
Dual 120 & 250 Watts $8.45

Thor Electric Speed Drills

201¼" Electric Speed Drill w/Jacobs chuck. 2400 RPM/115VAC. Now Only . . $14.95
400¼" Electric Speed Drill w/geared chuck. 650 RPM/115VAC $38.95

CHROME VANADIUM DRILLS

60 Pcs #1 to 60 C.V. . . $5.95
30 Pcs 1/16" to ½" by 64ths 1/4" shank Wood Cane. . $6.95
15 Pcs 1/16" to ¼" with single flat Special $1.98
8 Pcs Wood Bit Elec. Drill Set ¼" shank 1/4" to ½" per 1/16". Special $1.98

NEW 212W/SEC PHOTOFLASH AC & Dry Battery Kit

Includes four 525MFD/450V Condensers, total 2100 mfd. 12 pc. Resistors, capacitors, rectifier, flash tube in indicating flash gun, guide #80 Daylight Kodachrome, 240 on Flashcube. Less Batteries.
"TAB" Special—AC Only @ $44.98
(9) 90V (NOS) Batteries & Box @ $14.98
525MFD/450V/53W—Sects Cond. NEW in leaking famous mfr's carton . . . $8/$15
10MFD/2500VDC/60W—Sects. . . . $6; 2/$10

FOTO FLASH & STROBE LAMPS

No.	Replaces	W-Sec. Max.	Each
TLW	FA104/PT115	150	$0.98
THI	AMGL/5804X	100	10.98
TJW	GT-27	200	0.98
T3VA	6VLV, 4330	300	0.98
VX34	X400	250	10.98
TIV	DFA/A100	150	10.98
TDX	DXC/250-280	150	10.00
3S3GTG	PT505	2000	49.98
	Trigger coil for LO V Flash . . .		1.47

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4MFD 1200 VDC @ $1.25 EA.
10 MFD 600 VDC LOTS OF 12
Singly @ . . . . . $1.70 ea.
Lots 12—Any Assortment

NEW 6 KV HI SENSITIVITY DC & AC 27 RANGE MULTITESTER

"TAB" 60 $21.95
LOTS OF 3
(Not a Kit)

A complete precision test instrument. 20,000 Ohms per Volt DC—10,000 Ohms p/v AC. 3% micron-pere cont. service & up to 50 Amp intermittent overload. Model V612V12AC . . . $29.95

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Cased 0-270V 9A	41.40

230 to 115V Autoformers

For 220-240V/50-60 cy. In. To 110-120V or Step-up, W/ Cord, Plug & Receptacle:

TPA025/25W†	$7.50
TPA075/75W†	12.45
TPA100/100W†	14.00
TPA200/200W†	20.75
TPA300/300W†	27.25
TPA500/500W†	38.75
TPA750/750W†	54.75
Model TPA1000/1000W/1 KW†	$76.95
Model TPA2000/2000W/2 KW†	$124.50

$100 Order Take 10% Disc. *Less C.P.&A

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C6160M 8500MFD 15V	
1Pkg: 2/$1.50; 10/$5	
C6803M 3000MFD 60V	$3.00; 2/$7

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SYLVANIA CRYSTAL DIODES

IN23B $1.25 ea.

9 FOR $10; 100 FOR $100
IN21—Special @ 6 FOR $5.00; 100/$15

INFRARED SNOOPERSCOPE

SEE IN DARK TUBE

Selected, GTD Image-Converter Tube Hi-Sensitivity simplified design 2" dia. Willemite screen—Resolution up to 50 lin/in. Tube & Data. "TAB" $3.90; 2/$7.50.

Snooperscope Pwr. Supply 4600VDC/35MA. Using Dual Doubler Cckt. Transformer, Rectifiers, Sockets, Resistors, Capacitors and Diagram 115V/60cy Oper. $13.90

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Famous Soldering Guns

TA-S-4 Gun 135W $7.95
TA-B-4 100-150W $9.45
TA-B-6 200-275W $10.95
TA-10 Gun 180W $9.85
LENK GUN (Terrific) . . . $7.45

866A KIT & XFMR

(2) 866A Tubes, Sockets & Transformer. Rated PRI 115V/60 cy. SEC 2.5VCT/10A—Hi Volt Insulation. "TAB" Special Only $4.98

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• 1st Quality •

OA2	.70	6AF5	1.15	6X3	.45
OA3	.60	6AG5	.45	6Z7	2.11
OB2	.60	6AG7	1.14	7A4	.78
OC2	.60	6AH6	.98	7A8	.98
OC3	.60	6AK5	.60	7AD7	1.41
OD3	.75	6AK6	.70	7B6	.70
OZ4	.60	6AL5	.45	7B8	.80
1A6GT	.60	6AQ5	1.25	7C4	.86
1A7GT	.60	6AQ6	.45	7C7	.68
1AB4	2.00	6AQ8	.80	7E6	.90
1AC4	.75	6AS7	2.75	7F7	.70
1AH4	1.07	6AS8	1.60	7F7	.75
1AX2	1.25	6AT	2.48	7F8	1.18
1B3	.60	6AT6	.75	7N7	.70
1C6	.60	6AU6	.45	7N7	.85
1D8GT	.80	6AV6	.80	7Q7	1.20
1E5	.80	6AV6	.80	7Q7	1.20
1E7	.60	6AX4	.80	7K6	.88
1G4GT	.60	6B4	1.12	7Y4	.64
1G6	.80	6B6	1.12	7Z4	.64
1G6GT	.70	6B7	.01	13A6	.48
1M4G	.45	6B8	.64	12A8	.75
1N5GT	.80	6BA6	.45	12AH7	.90
1H6	.65	6BD6	.70	12AL5	.60
1G6	.75	6BE6	.48	12AT6	.40
1L4	.70	6BE6	1.20	12AT7	.90
1LA4	1.01	6BH6	.80	12AU7	.80
1LB4	1.09	6BJ6	.80	12AV6	.35
1LC6	.65	6BK7A	1.11	12AW6	.55
1LD5	.80	6BL7	.98	12AX7	.85
1LE3	.90	6BN6	1.10	12AY7	.65
1LN4	1.00	6BQ6	.90	12BA6	.50
1LN5	.75	6BZ6	.90	12BA7	.90
1P5	.78	6C5	.68	12BE6	.60
1Q5	1.10	6C8	.82	12BH7	.80
1R4	.90	6C8G	.80	12C8	.60
1R5	.80	6CB6	1.08	12H6	.45
1S4	.80	6CS6	.80	12J5	.45
1S5	.60	6D6	.80	12K5	.45

"TAB" TESTED GUARANTEED

1T4	.50	6F8	1.09	12SC7	.78
1T5	.80	6F8G	.88	12SF7	.80
1U4	.48	6F8	.88	12SH7	.60
1U5	.48	6G6	.90	12SJ7	.60
1V2	.65	6H6	.60	12SK7	.60
1X2A	.60	6J4	4.50	12SL7	.86
2A4	2.37	6J5	.40	12SQ7	.60
2A5	.75	6J6	.80	12SR7	.60
2A6	1.40	6J7	.70	12Z3	.85
2A7	.88	6K6	.48	14A7	.85
2B7	.80	6K7	.48	19BG6	1.45
2E5	.62	6L6	1.09	19T8	1.49
2V3	2.90	6L6	.90	19V8	1.96
2X2A	1.16	6L7	.78	24A	.90
3A4	.67	6M7	.78	25A6	1.70
3B4	2.70	6P5	.90	25BQ6	.90
3B7	.84	6Q7	.81	25L6	.42
3C6	.80	6R8	7.40	25Y5	.80
3D6	.48	6S4	.48	26	.78
3S4	.48	6S7	1.30	28D7	1.20
3V4	.48	6S8	.80	30	.70
5AR4	1.22	6SA7	.80	35A5	.70
5AZ4	.80	6SC7	.70	35B5	.84
5BP4GY	.98	6SD7	.70	35C5	.68
5T4	1.48	6SG7	.60	35Y4	.80
5U4G	.45	6SH7	.40	35Z3	.48
5V4	1.25	6SK7	.40	35Z4	.48
5X4G	.78	6SN7	.60	35Z5	.68
5Y3	.65	6SL7	.55	4S23	.66
5Y4	.65	6SQ7	.55	45	1.20
6A3	1.30	6SQ7	.55	50A5	.68
6A8	2.98	6S57	.80	50C5	.52
6AB4	.81	6T8	1.20	50L6	.52
6AB7	1.00	6T8	.75	71A	.70
6AC7	1.09	6U8	.90	75	.85
6AD4	.80	6U7	.60	76	.68
6AE7	.78	6V6GT	.60	77	.68
6AG5	1.19	6W4	.35	83V	1.33
6AG7	.68	6X4	.40	117Z3	.69

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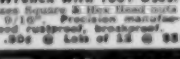

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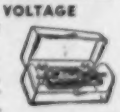

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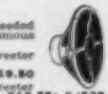

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